HARDWARE . . . . SOFTWARE . . . . AT HOME . . . . IN BUSINESS

computing today

JANUARY 1981
ISSN 0142-7210
60p

FOR THE BUSINESS OF MICROCOMPUTING

PROGRAM AT SPEED

-routines to make light of long listings

Putting the PC1211 to work in business

Better tape control for improved data storage

Graphic explanations on the MZ-80K and NASCOM

Disc drive details you should know

LOOKING AT VDUs? CT Buyer's Guide screens the facts

Unique in concept—the home computer that grows as you do!

The Acorn Atom

£120

plus VAT and p&p

Special features include

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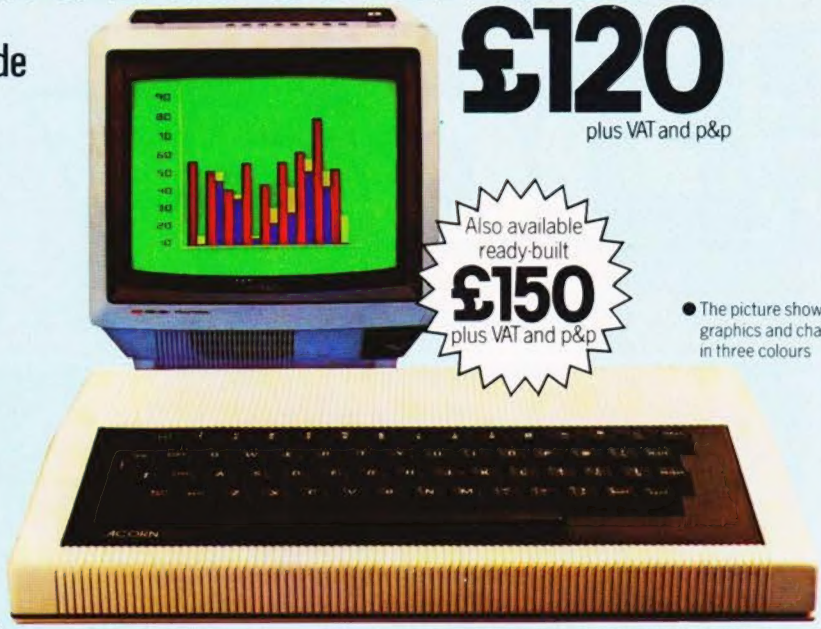
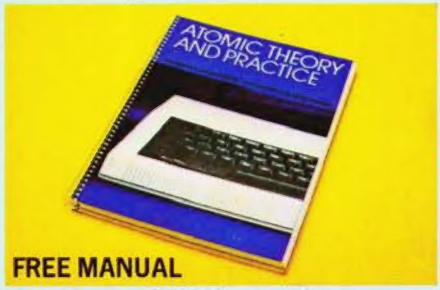
* ASSEMBLER AND BASIC
* TOP QUALITY MOULDED CASE
* **NEW!** Colour Encoder for full colour graphics **£21.50**



Also available ready-built **£150** plus VAT and p&p

● The picture shows mixed graphics and characters in three colours

The Acorn Atom is a definitive personal computer. Simple to build, simple to operate. A powerful, full facility computer with all the features you would expect.
Just connect the assembled computer to any domestic TV and power source and you are ready to begin. (Power requirement: 8V at 800mA). There is an ATOM power unit available – see the coupon below.



FREE MANUAL

Free with every ATOM, kit or built, is a computer manual. The first section explains and teaches you BASIC, the language that most personal computers and the ATOM operate in. The instructions are simple and learning quickly becomes a pleasure. You'll soon be writing your own programs. The second section is a reference manual giving a full description of the ATOM's facilities and how to use them. Both sections are fully illustrated with example programs.

The standard ATOM includes:

HARDWARE

● Full-sized QWERTY keyboard ● 6502 Microprocessor ● Rugged injection-moulded case ● 2K RAM ● 8K HYPER-ROM ● 23 integrated circuits and sockets ● Audio cassette interface ● UHF TV output ● Full assembly instructions

SOFTWARE

● 32-bit arithmetic (±2,000,000,000) ● High speed execution ● 43 standard/extended BASIC commands ● Variable length strings (up to 256 characters) ● String manipulation functions ● 27 x 32 bit integer variables ● 27 additional arrays ● Random number function ● PUT and GET byte ● WAIT command for timing ● DO-UNTIL construction ● Logical operators (AND, OR, EX-OR) ● Link to machine – code routines ● PLOT commands, DRAW and MOVE

The ATOM modular concept

The ATOM has been designed to grow with you. As you build confidence and knowledge you can add more components. For instance the next stage might be to increase the ROM and RAM on the basic ATOM from 8K + 2K to 12K + 12K respectively. This will give you a direct printer drive, floating point mathematics, scientific and trigonometric functions, high resolution graphics.

From there you can expand indefinitely. Acorn have produced an enormous range of compatible PCB's which can be added to your original computer. For instance:
● A module to give red, green and blue colour signals ● Teletext VDU card (for Prestel and Ceefax information) ● An in-board connector for a communications loop interface – any number of ATOMs may be linked to each other – or to a master system with mass storage/hard copy facility ● Floppy disk controller card. For details of these and other additions write to the address below.

ACORN COMPUTER 4a Market Hill, CAMBRIDGE CB2 3NJ

Your ACORN ATOM may qualify as a business expense. To order complete the coupon below and post to Acorn Computer for delivery within 28 days. Return as received within 14 days for full money refund if not completely satisfied. **All components are guaranteed with full service/repair facility available.**

Quantity	Item		Item price inc. VAT+p&p	TOTALS
	ATOM KIT–8K ROM+2K RAM (MIN)		@ £140.00	
	ATOM ASSEMBLED–8K ROM+2K RAM (MIN)		@ £174.50	
	ATOM KIT–12K ROM+12K RAM (MAX)		@ £255.00	
	ATOM ASSEMBLED–12K ROM+12K RAM (MAX)		@ £289.50	
	1K RAM SETS		@ £11.22	
	4K FLOATING POINT ROM (inc. in 12K Version)		@ £23.30	
	PRINTER DRIVE	6522 VIA	@ £10.35	
	(inc. in 12K version)	LS244 Buffer	@ £3.17	
	COLOUR ENCODER		@ £21.50	
	MAINS POWER SUPPLY (1.3 amps)		@ £10.20	
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CONTENTS

VOL 2 No 11 JANUARY 1981

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Details on view. p.79.

Double decker discs. p.28.

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NANOCOMPUTER®

THE COMPUTER FOR LEARNING ALL ABOUT COMPUTERS.

The microprocessor boom has left in its wake a scarcity of engineers who need to know how to realise to the full the potential of these powerful devices.

SGS-ATES, who have been producing microprocessors longer than any other European manufacturer, are now producing the NANOCOMPUTER, a professional and complete educational microcomputer system specially designed for learning all about microcomputers.

NBZ80-S. CPU board, experiment board, keyboard, card frame/power supply, connecting wires, training books Vol. 1 and 3, Technical Manual.

Teaching and Learning: two facets of a single problem.

All learning must be a blend of teaching reinforced with practical training.

The NANOCOMPUTER has been designed to be both tutor and training aid.

It is the result of SGS-ATES many years experience not just in component and systems production but also in the training of both design and production engineers at the very highest level.

The NANOCOMPUTER, based on the powerful Z80 microprocessor produced by SGS-ATES, is not just a microcomputer but rather a complete, modular educational system designed to grow with the student.

It comes complete with text books in the major European languages, technical manuals and experiment kits.

All these features make the NANO-

COMPUTER an obvious choice not only for supervised courses in schools but also for the engineer who wants to learn in a more personal way all about microcomputers.

NANOCOMPUTER: a modular system.

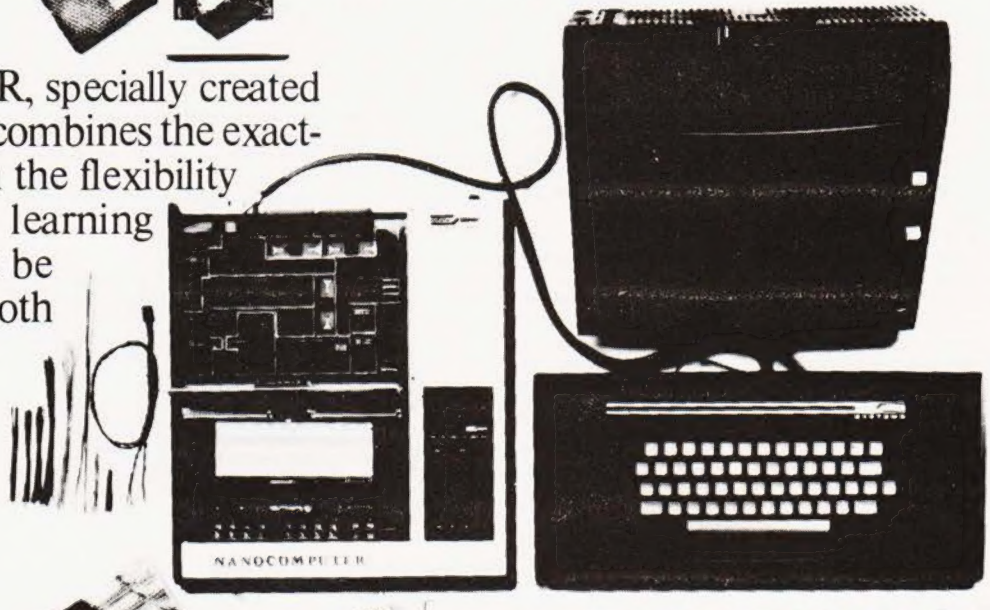
The conceptual design of the NANOCOMPUTER, specially created for educational use, combines the exactness of science with the flexibility demanded by the learning process which must be at the same time both theoretical and practical.

The NANOCOMPUTER in its simplest form, NBZ80-B, allows even the newcomer to microprocessors to master programming techniques.

Further up the scale the NBZ80-S introduces him to logical circuits then takes him on to learning how to interface a microprocessor with external devices.

Each learning step taken by the student is matched by the NANOCOMPUTER which has been designed for expansion, with a series of upgrade kits, from the simple NBZ80-B through to the NBZ80-S onto a final version with which he can learn not just about programming in the BASIC high-level language but how to use it as an integral part of a hardware system.

NBZ80-B. CPU board, keyboard, card frame/power supply, training book Vol. 1, Technical Manual.



NBZ80-HL. As NBZ80-S, with 16k bytes of RAM, expansion board with 8k BASIC ROM, video interface board, alphanumeric keyboard, book "BASIC Programming Primer". (TV monitor is optional).

VISUAL BOX

OEM and systems builders will undoubtedly find the new Vero Saturn VDU and keyboard cases a low-cost solution to their casing needs. Made in two sizes, 12" and 15", they are fully equipped with facilities for CRT mounting, fans and even have a matching peripherals case for items such as floppy discs or modems. The keyboard sections are separate and supplied with a blank metal panel. For complete details and prices contact Vero Electronics at Industrial Estate, Chandlers Ford, Eastleigh, Hants SO5 3ZR.

FAST EPROMS

Micro people in a hurry to get their PROMs blown will be interested to hear of a 'same-day' service being offered by Petron Electronics of 1 Courtlands Road, Newton Abbot, South Devon. For 60p they will erase and for a further £2 per K they will reprogram the 27 and 25 families. Listings are available for an extra 50p and p&p and VAT must be added.

NATIONAL NETWORK

Tandy owners, under the guidance of the National TRS-80 Users Group, are to get their own computerised bulletin service. As well as providing a central message service it will also contain the group's library of software and members will be able to directly down-load programs. Other systems, Apples etc., should be able to use the system given the necessary hardware and software. Potential users of the system or people just interested in joining the TRS-80 group should contact Brian Pain at 40a High Street, Stony Stratford, Milton Keynes.

BBC NEWS

Once again the weekly trade papers have jumped on a potential story ahead of time and have caused a considerable amount of misinformed comment to be printed. The news about the BBCs involvement in a micro education project has been circulating recently, but Computing Today is fortunate in having a source of detailed information close to the project team. Shortly after the news was printed in the trade press we received a letter from our source which we have been asked to print in order to clear up any misunderstandings about the project.

Dear Computing Today
The BBC is engaged in developing a multi-media computer literacy project, which it is hoped will be ready for the public in Autumn 1981. The project will consist initially of ten half hour television programmes, a number of publications on different aspects of computing, an associated course in BASIC programming to be run by the National Extension College and the launch of a BBC microcomputer to be sold by mail-order at less than £200. Plans are well advanced for the publications and a numbers of authors, who already have titles on the 'personal computing' bookshelf, have been asked to contribute. Also, negotiations on the hardware have reached an advanced stage.

The BBC hopes to announce very soon that it has concluded a licensing agreement with a Company well-known in the computer business, to market a stripped down variation of their new project under BBC house colours.

The BBC micro will be marketed by BBC Enterprises Limited, which is in fact an entirely separate commercial entity. Because of this, an ironical situation exists in which, however successfully the television series promotes the hardware, there can be no financial return from Enterprises back into the programmes. As far as the BBC is concerned, the purpose of marketing their own machine is based on two things. Firstly, it allows the series to show programs in a standard language using a standardised operating system without having to worry about portability. The second point is that the BBC feels that offering a micro with their name on it is likely to introduce the technology to a much wider audience than at present. This can only be good for the micro computer market in general.

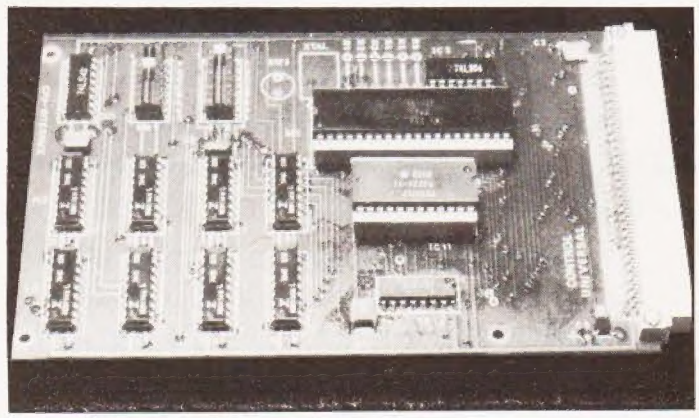
Buyers of the BBC computer will subsequently, if they wish, be able to purchase an 'add-on' pack which will bring their micro up to the full specification and cost of the original model.

The programmes will be produced by Paul Kriwaczek, who has previously produced mainly Drama and Arts programmes, and he is hoping to bring some entertainment to the subject. The aim of the television series is, at least in part, to de-mystify computers and show the many opportunities that the new micro-electronic technology can offer ordinary people in their own homes.

The Pilot programme is in an advanced stage of preparation and when recorded, will be shown to selected groups of potential viewers during the next few months. The Pilot programme will be presented by Chris Serle, well known from THAT'S LIFE and MEDICAL EXPRESS. He will be joined by reporter Sarena MacBeth and Computer Consultant, Jonathan Baldachin, one of the partners of the 'little Genius' software house which specialises in micro-computer education.
Best Wishes!
Micro Mole

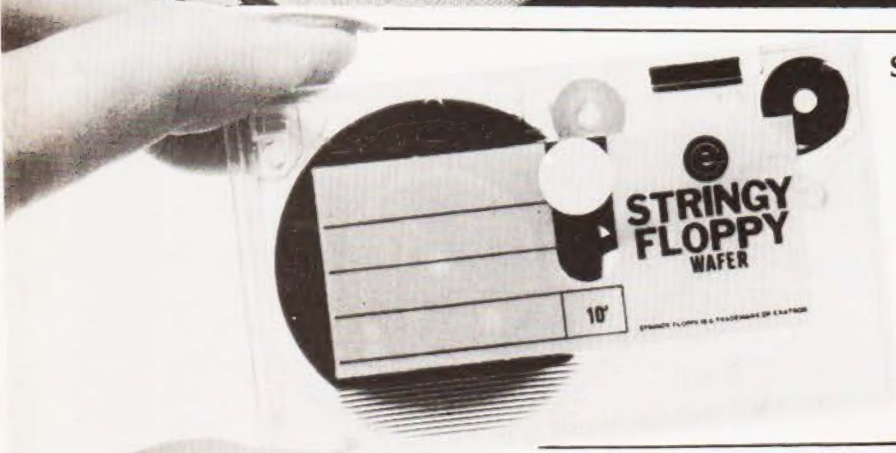
DATA DOCTOR

Worried about your 25-way cable's health? Then give it a check up with a new British product called (surprise surprise) a 25 Way Cable Checker. Produced by Thames Electronics of 9 The Precinct, Hurst Park, West Molesey, Surrey it costs £165 plus VAT and will identify short and open circuits. For a further £160 plus VAT you can have a matching Breakout box — no it doesn't play games — which will allow you to check out the signals that are being driven and even to patch over some of those little quirks like the infamous pin 20.



POINTED DOS

Crystal Electronics have managed to get the CP/M 2.2 operating system up and running on the Sharp MZ-80K. For around £200 it opens the door to all those programs written under CP/M and only takes an overhead of one small board inside the machine. Crystal have also produced their own BASIC which runs in only 9K. Most local Sharp dealers should be able to help but if you want more technical information contact Crystal at 40 Magdalene Road, Torquay, Devon.



SOAK IT UP

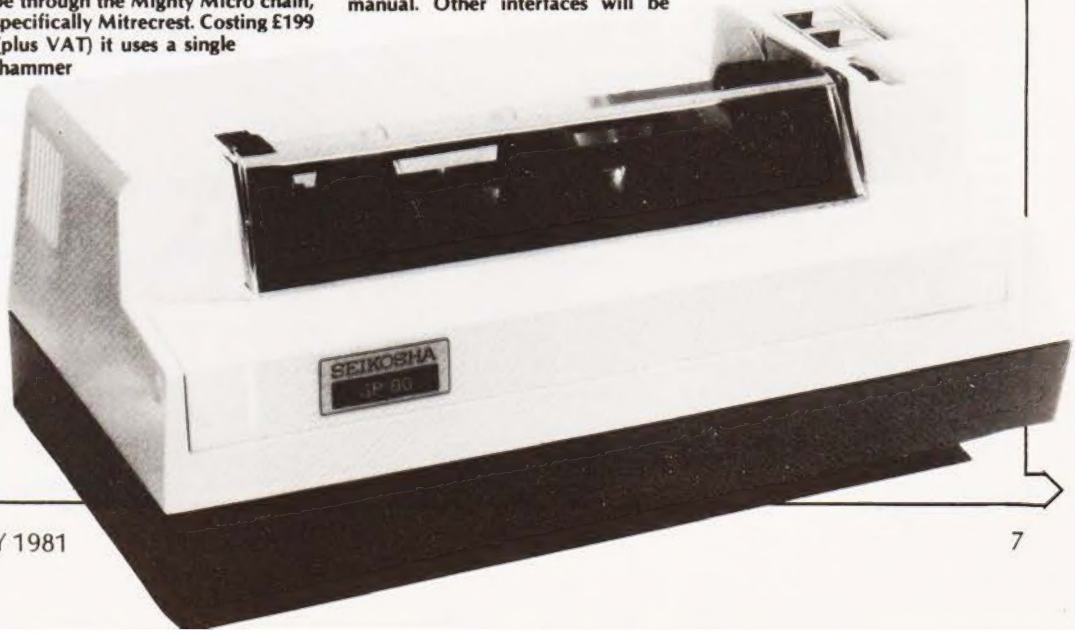
A new version of the 'Stringy Floppy' has been announced by MBS Terminals of Aldwych House, Madeira Road, West Byfleet, Surrey. Rather than being a machine-specific version it uses the RS 232C serial interface for data entry. Called the Micro Sponge it will hold up to 80K bytes per wafer and the unit can stand-alone with its internal power supply. Controlled by a Motorola 6803 with 2K of ROM it can handle data at up to 1K per second using transmission speeds of 1200 or 9600 baud. Communication is in a sequential format, but because it uses files it can work much faster than a cassette type system as it searches for the given file. Possible areas of application are data logging, personal data storage and off-line file storage.

6502^3

Make your AIM into a double decker with a new card from Control Universal. By removing the 6502 and plugging in the new card into its socket, with the 6502 installed on this new card, you instantly gain an EPROM socket for up to 4K, another 4K of RAM, a 16 line parallel I/O port and an Acorn bus connector. The memory locations of both the RAM and EPROM can be seleced by DIL switches. With a little bit of careful thought it should be possible to put a simple machine code monitor into the EPROM and you would have a very neat little control processor. For information contact Control Universal at 11-15 Bush House, Bush Fair, Harlow, Essex CM18 6NS.

ONE AT A TIME

Seiko have moved into the computer peripherals market with their uni-hammer printer. UK distribution will be through the Mighty Micro chain, specifically Mitrecrest. Costing £199 (plus VAT) it uses a single hammer head which allows 30cps print rate and an 80 character line and is capable of drawing graphics. Supplied with the printer is a Centronics interface and cable as well as a manual. Other interfaces will be available for most of the popular machines. For full specification contact Ian Jones at Mitrecrest, 61 New Market Square, Basingstoke, Hants RG21 1HW or ring on 0256-56468.



IT'S MAGIC

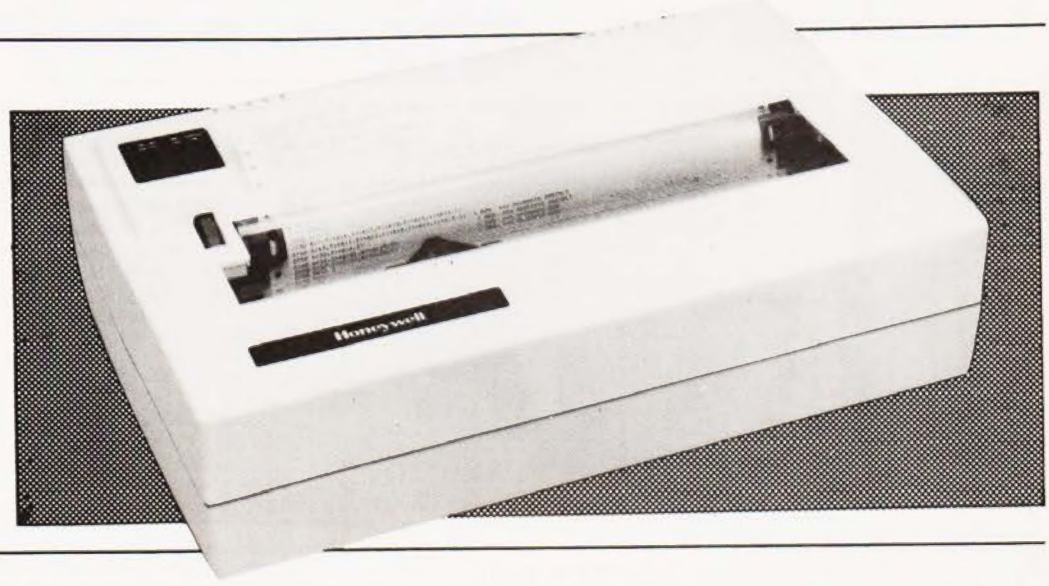
A new word processing system called Word Magic was recently shown at The Sunday Times business exhibition in Manchester. The basic system will cost about £6500 and provides the starting point of a multi-user system. Based around the Magic Wand package it features a 64K processor, twin discs and a daisy type printer. It also includes a BASIC compiler and a special report generating program for lengthy documents. A typical three station system would cost less than £12000 and that includes 10M of disc storage. The Magic Wand software uses single keys to activate all the separate processor functions and a tutorial disc is included to give self-training. For a more detailed information package contact Computer Information Services at 221 Seven Sisters Road, London N4 2DA.

OFF THE SHELF

Computer room managers will probably breathe easier when they see the enormous selection of media available from Wilkes Online Stores. Their new catalogue also includes details of a new custom form designing service for small businesses along with all the usual tapes, labels and other vital goodies that the average computer gobbles up in the course of a year. The new business form service is called Quickform and if you feel that you can tackle the design yourself then they will send you a design sheet so that you can convert your normal headed documents into computer stationery. Plain listing paper is also available for most of the common micro printers as are labels and printout binders. For your copy of the catalogue contact Wilkes at 4 Abercorn Trading Estate, Manor Farm Road, Alperton, Middx HA0 1FQ or check in Yellow Pages for your regional offices.

HONEYWELL DUO

Amongst the ever growing world of printers for microprocessors two models have emerged from a slightly unexpected quarter. Announced by Honeywell they are the S10 and S30 matrix printers, basically similar 80 cps bi-directional machines but the S30 has a 132 column capacity. Other standard features are the 7 by 7 matrix head and the tractor feed. The intended market is for the small business or office but personal computer users who want a quieter printer may be interested. The prices are £510 and £690 for the two models and they are available from MBS Terminals Ltd., Aldwych House, Madeira Road, West Byfleet, Surrey.



HEAVENLY TWIN

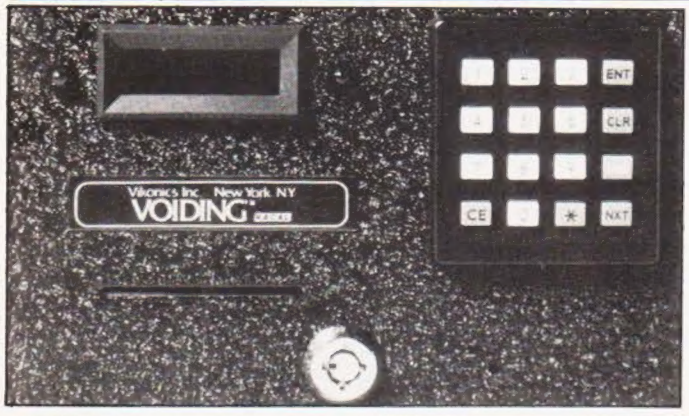
Among the new products launched at the Compec extravaganza was Gemini. Designed by one of the founding fathers of Nascom, John Marshall, it features twin 5¼" floppy discs running under CP/M and is based around a Z80. The main board contains 64K of RAM along with all the other vital parts and includes the new MC6845 graphics chip. Two screen formats, 80 by 25 and 40 by 25 are available and all the characters are held on disc and down-loaded rather than using a standard set. Expansion is by way of a 50 pin bus and an RS232 serial port is supplied as standard, a parallel port is an optional extra. Two cut-down variants are available, the Model 801A which is without the floppies, and has a machine code monitor, 8K BASIC and a cassette port. The second model is the 801B which is a naked version of the 801A. Prices range from £575 for the naked version to £1075 for the fully configured Gemini. Further technical information is available from the company at Oakfield Corner, Sycamore Road, Amersham, Bucks.

NCR UPGRADER

Current users of NCR 299 electronic accounting systems who are thinking of upgrading to a small computer may be interested to hear about a new conversion package being offered by NCR. Consisting of program conversion, training and trade-in allowances it will allow the direct use of the I-8140 micro based system. Although the 8140 is a disc based system it can still handle data in the same formats as the 299 thus allowing a quick change-over. Interested customers should contact NCR direct.

WORDS ON DATA

Business people interested in acquiring a wordprocessor that can do more than just process words might like to take a look at the Jacquard range. A new London company, Wordata, is handling the distribution of both the "stand-alone" J500 and the more powerful and flexible J100 machines. The company offer direct purchase, lease or rental terms as well as operating a bureau service. All the staff are familiar with the field of operation and they can offer full customer training and after-sales service. They can even supply WP trained personnel in the case of a staff shortage. The company has recently moved into new and larger premises at 64 Gloucester Place, London SW1. The new telephone number is 01-486 6211.



FREE DATA

Those champions of the chip business, Texas Instruments, are extending their amazing databook offer. For the price of the TTL Data Book, £7.80, you will also receive the 9900 System Design Manual, the MOS Memory book, the Interface Circuits book, the Linear Control data book and a whole load of short-form brochures. Grab this offer while it's still going because it has got to be the best bargain of the year. Order your set direct from Texas Instruments as the 'Microelectronics Reference Library'. They live in Manton Lane, Bedford MK41 7PA.

CARD KEY

Computer room security is a problem that will soon face the small system user. One offering is a card based lock with an 'English language' display of status and function which can cope with up to 1000 cards. In a high traffic situation it can be used as a 'card only' entry system or with a reduced traffic level it offers an additional 4 digit key code for extra security. The new device is backed by a nationwide service network and includes some self testing functions so reducing the embarrasing possibility of 'lock-out'. For full product information contact Modern Alarms at 25/26 Hampstead High Street, London NW3 1QA.

BROKING AWAY

Electronic Brokers, the second-user people, have moved into new headquarters following the increase in turnover of their second-hand equipment. As well as their comprehensive stocks of second-user goodies they also carry a range of brand new equipment ranging from oscilloscopes to multimeters, all of which can be demonstrated on site. The new premises are at 61-65 Kings Cross Road, London WC1X 9LN and the phone number is 01-278 3461

SECOND SOURCE

LSI Computers have recently announced the introduction of a new small business machine based around the 8085 CPU. Designed to complement the existing M-One it is supplied complete with a range of business software and features 64K of RAM, dual floppies and a Winchester disc. Up to four VDUs can be driven from the processor plus up to two printers. The storage capacity is 600K on the floppies with an additional 5.3M on the hard disc but this can be expanded to 58M if required. Prices will range from £7900 to about £15,000 depending on the configuration chosen. For more product information contact LSI Computers at Copse Road, St Johns, Woking, Surrey GU21 1SX.

computing today

FEBRUARY 1981
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FOR THE BUSINESS OF MICROCOMPUTING

ON SALE AT YOUR NEWSAGENT 9th JANUARY

BLACK MAGIC

Hidden deep within the silicon substrate, encapsulated in midnight black resin and equipped with forty delicate legs the heart of a Z80 processor beats strongly. But it has a secret. Even the manufacturers are reticent about it so we sent our modern-day Sherlock Holmes on a trip into the interior of one to find out. The amusing, and very useful, results of his investigations will be published next month. Who knows, this might start a new game — how to find out what your micro manufacturer won't tell you.

AN 'L' OF A PROGRAM

Learning your highway code is usually the most trying part in the preparation for a driving test. This program acts as a tutor and contains many of the common questions that you might be asked. In addition to this useful function it also demonstrates a very simple and powerful way of handling textual and numerical data. Learn more than you bargained for with this instructive program in our February issue.

MICRO RADIO

The fascinating world of Amateur Radio and its connection with the world of the personal computer are unveiled in our next issue. Expand your horizons with RTTY or go for a satellite link, the world can be yours to tune in to.

WORDY STUFF

Fans of word puzzles can now have an endless supply of them with this extremely clever program. All you have to do is try and find the words that it's hidden inside the square, and it's not easy! Ideal for insomniacs or those just bored with crosswords.

Articles described here are in an advanced state of preparation. However, circumstances may dictate changes to the final contents.

PET SOFTWARE

D.S.L. BASIC MANAGER

Up to 9 BASIC programs stored in RAM at any time – CALL and RUN under menu control or use remainder of RAM for normal BASIC operation.
cassette + full documentation, £12.50

D.S.L. WORD PROCESSOR

A low cost but very powerful word processor suitable for the office/small business user. Features autocentering, justification, delete, insert, copy, etc. with print format control via text imbedded characters.
cassette + documentation, £20.00
(state new or old ROM machine)

ooo

We also stock a range of software for the small business user and will quote for customised software for the PET or Intertec SUPERBRAIN. Hardware available at competitive prices. Please ask for quotation.

ooo

above prices inc. VAT & postage

DRAGON SYSTEMS LTD

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7 SEGMENT DISPLAYS HEWLETT-PACKARD High Efficiency "ultra bright" half inch, red. Common anode type 5082-7650 (similar to DL707) Common Cathode version 5082-7653 (similar to DL704) OUR PRICE BRAND NEW £1. Set of six of either type £5 incl VAT. — HALF PRICE OFFER

FAIRCHILD FND10 0.25" Max red 7 segment display Common anode 50p 5 for £2.50

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LP1171 and LP1179 tuning board and IF modules which form the basis of a quality AM/FM tuner. Full medium long wave and VHF coverage. May be used as the basis of a quality portable or tuner. Supply 9V at 15mA output 70mV at 20K. Pair £5.75.
SUPPLIED COMPLETE WITH DATA
LP1157 Medium & Long Wave Tuner, module-board £2.50 LP1186 Varicap £5.00

5+5 Watt Car Stereo Amplifier made for Motorola

- WITH pre amplifier and M. & Long Wave assembly.
- Supplied as two built and tested units.
- R.F. and I.F. stereo preamplifier and radio 4 x 2 x 1".
- 5 + 5 watt stereo amplifier 12/14 volt 4 x 2 x 1"
- Complete with circuit, data and connection diagrams.
- Limited quantity available, ex-stock.

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PRO M25 Professional capacitor boom-arm microphone by Eagle. A graceful 60 cm boom-arm capacitor studio microphone using a cardioid capsule. A high standard of finish for in-vision use and yet robust enough to withstand long periods between maintenance. Supplied complete with 1 rod and 1 black windshield and 6 metres of twin screened cable terminating at the microphone end in an XLR connector.
Impedance: 600 ohms (floating) Response: 20-18,000 Hz. Sensitivity: – 70 dBV. Cable: 6 metres two conductor shielded. Connector: XLR 3-11C. Battery type: HP7.
LIST PRICE £37.40
OUR PRICE £19.95 inc. VAT
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DRYFIT RE-CHARGEABLE BATTERY. 6 volt 4.5 amp/h. Size 6" x 3½" x 1½" at half price. Broad new £7.50, post 50p
MIN. EDGE INDICATORS WITH LAMP. 0-100 MICRO AMP 6 for £6.50
INDICATOR METERS. 200 Micro. 1½" x 1½" x ½". 6 for £5
TRANS. AMPLIFIERS. Contains two Faster type moving coil, mikes/earphones, V/C and switches as used on aircraft for passenger listening. £1.50 P.P. 25p. 10 for £12.50
SANGAMO HOUR METER. 9999.9 non reset. £4.50. 1½" sq. 2" deep.

MAINS TRANSFORMERS all 200/250V input

Type	Current	Size	Price
12V	100m/a	1½x1½x1½	£0.95
12V	500m/a	1¾x1¾x1¾	£1.35
6-0-6	300m/A	2x2x2	£1.50
12V	2 amps	3x2½x2½	£2.95
8-20V	1 amp		£2.50
12-20V	1 amp		£2.50
14-0-14V	1.5 amp		£2.50
12V	1 amp		£2.50

Size 6x5x5cm. Postage 50p each

2W MIN. W/W VOL. CONTROLS 100-47K. 10 for £6

10 TURN POTS. 47R-100K. 10 for £17.50

MULLARD TBA800. IC audio amplifier. £1.
RCA CA3089. FM IF £1.50.
RCA CA3090AQ. FM decoder £2.50.
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PASCAL-WHO'S AFRAID?

The end of the controversy? It could be just the beginning!

A number of articles have appeared in personal computer journals recently attacking, and defending, the computer language Pascal. "Pascal — a False Idol?" by A P Stephenson in the September 1980 edition of Computing Today seems to be fairly typical. It takes a somewhat emotional line, with its references to Pascal as the "darling" of the computer world, structured programming as a "fetish", career programmers as "poor souls" and to people promoting the new by denigrating the old. Mr Stephenson writes as though he feels threatened by Pascal, as though he fears an either/or situation vis-a-vis BASIC. I am sure there is no need for anyone to feel defensive about the situation. Pascal and BASIC will probably co-exist quite happily and other languages will also have their place in the computing scene. I would like to try to put forward a point of view which will correct the perspective a little.

Professional Viewpoint

What is that point of view? I am an electronics engineer, having been in the business since the days when things took a long time to warm up and you had to switch off before you started to poke about inside the circuit. I call myself a professional engineer, and take pride in both parts of that title. I have watched the approach of microcomputers over the years with a mounting sense of excitement. Having had a chance to use them, I have not been disappointed. In the opportunities they provide for creative engineering, they are the most important things to arrive during my lifetime. It follows, almost without saying, that I have bought my own microcomputer. Although it is a modest set-up, I have caught a bug that will be with me for the rest of my days.

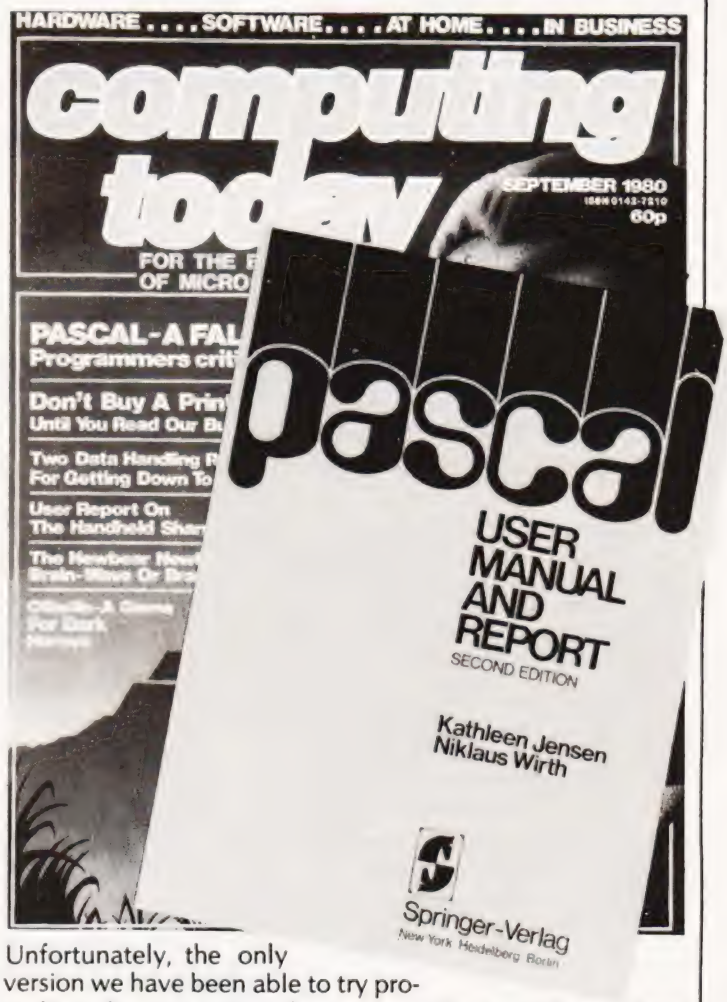
As a professional engineer, I am 100% in favour of structured programming. It is not enough for me and my colleagues to write programs that work. Our programs must also;

be easy to test
be easy to modify
be fully documented.

If we write obscure programs we are simply not doing our jobs. I have not yet come across anything better than structured programming for ensuring that these three objectives are met. I believe that the principles of structured programming have something to offer to amateurs too, particularly if they want their programs to be adaptable to different machines or different versions of languages. I have just been translating a version of "Startrek" written in Tiny BASIC to run under Crystal BASIC. I had no end of trouble which arose from one particular feature in the original program. There are no prizes for guessing that it was the abandon with which our old friend the GOTO statement had been used. Structured programming has not been devised by kill-joys. It is a discipline seriously directed at better programming, and its benefits greatly outweigh its apparent restrictions. It is perhaps significant that versions of "Structured BASIC" are beginning to appear on the scene.

Pascalian Solutions?

Pascal is a language whose form makes you write structured programs without trying, or, indeed, almost without your knowing. This results in compact, readable programs that are easy to debug. I think it is significant that all of my colleagues who have been exposed to Pascal have taken to it as enthusiastically as I have and would like to use it exclusively.



Unfortunately, the only version we have been able to try properly so far was written for a micro. The compiler we have managed to get for our mainframe computer uses so much core-store that practically no-one else would be able to use the computer if we ran Pascal. There seems to be a message for somebody there.

The main problem with Pascal for micro owners, at least at the moment, is that it needs a disc operating system. Certainly, there is at least one version of "Tiny" Pascal available which can be run on small systems, but its usefulness is severely limited by the absence of sine, cosine and other such useful functions. Its status is similar to that of Tiny BASIC, which is useful for small micros and can be used for games, but whose limitations can be irksome when you are trying to do anything ambitious. Its main value will be in introducing people to the concepts of a structured language.

Supplement Not Substitute

I don't believe that BASIC is in any way threatened by Pascal. It is, and will remain, a beautifully simple language to use. It has its rules, which you must learn in order to be able to use it to its full potential, but you can write programs with it after a minimum of tuition. Some versions of BASIC have very attractive features, and, in this context, I rate Crystal BASIC highly. It takes up a little less than 8K of memory, and the latest version allows you to incorporate your own special functions. This last feature makes it extremly useful to anyone who is willing to get involved in machine-code programming.

I am sure that BASIC has a long and useful life before it. But don't be too quick to dismiss Pascal. It may have something to offer to *all* of us.

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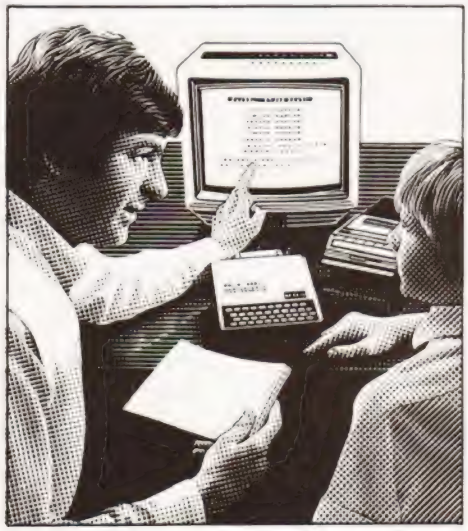

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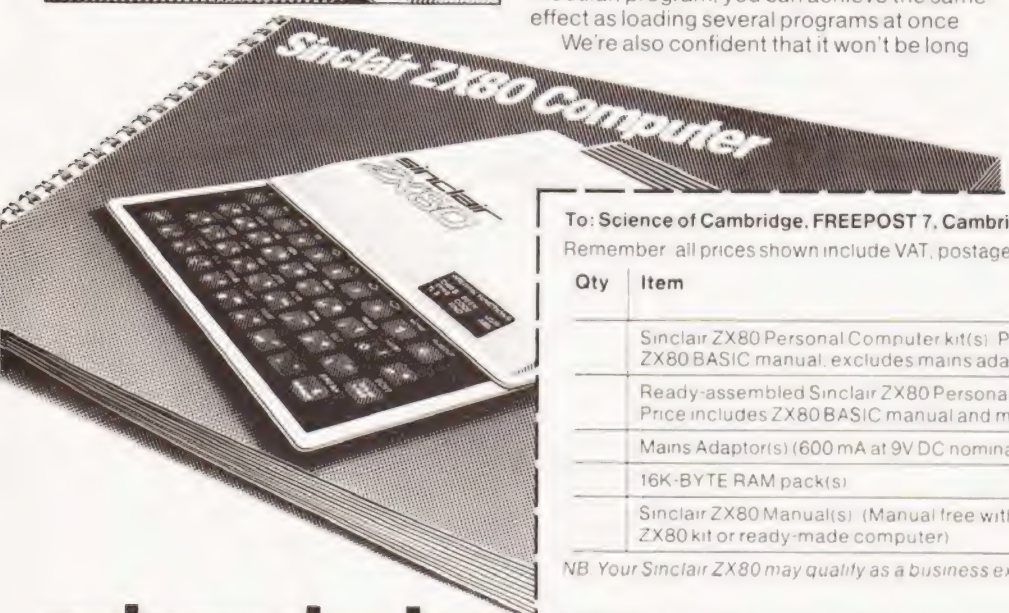

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Sort out your BASIC with this utility

Firstly, a note about the listing. Unlike most assemblers unidentified numbers are taken to be Hex and decimal numbers are identified by a trailing '.' i.e. 17=17H 17.=17D. To explain the programs we must first look at how BASIC programs are stored. The address of the bottom of the program is stored at address (105E). The first two bytes of a line hold the address (in Hex) of the next line. If these bytes equal 0000 this indicates the end of the program and the address following these bytes is stored at the top address (10D6). The second two bytes hold (in Hex) the BASIC line number. Following this is the line data terminated by a single 00. Commands are stored as single bytes in the range 80 — CF. GOTO, GOSUB, RESTORE and THEN being 88 8C 8B and A9 respectively. To renumber we first run through the data portion of each line looking for GOTO/GOSUB/RESTORE/THEN. If THEN or RESTORE is not followed by an ASCII decimal digit it is ignored, (if it was 'THEN GOTO' or 'THEN GOSUB' the GOTO/GOSUB will be picked up later). Data within quotes and REM statements are ignored.

A BASIC routine at E836 is used which searches a line pointed to by HL until it comes to a non-space, it then returns with "carry" set if an ASCII decimal digit is found, "zero" set if 00 found. When a valid command is found the BASIC line so far is copied into a buffer, (a new line number cannot be inserted in situ as it may be of different length). A BASIC routine is used to convert the ASCII line number to Hex which is returned in DE. Search is then made through the BASIC program for this line number, at the same time counting up in tens to find what the line number will be (if no comparison is found 0 is used). The new line number is then put in HL and a routine at F9AD converts it to ASCII and prints it on the screen, this is then copied into the buffer.

If the original number is followed by a comma then it must be 'ON GOTO/GOSUB' so another line number follows and this is treated in the same way. If the rest of the BASIC line is of different length to the old, the top of the BASIC program is moved to make room or fill in. The new line is inserted and the first two bytes of each line altered to point to the new positions of each line. A return is then made to the search routine, carrying on from where we left off. On reaching the top of the program the BASIC line numbers are altered starting with 10 in increments of 10.

The program is loaded via the monitor and is called by BASIC with DOKE4100,3200:A=USR(0). Return to BASIC is made via a warm start as it needs to be initialised to the new length. The routine is fairly fast, a 12K 500 line program renumbers in about 15 S at 2.5MHz. T4/BBUG users will need to change the program as follows:-

Cursor not required, replace lines 0D30 to 0D90 inclusive with

```
LDA 1F
CALL CRT
LD HL (LINNUM)
CALL PHTOA
LD DE 0B8A
NOP
```

Replace lines 1260 to 12B0 inclusive with

```
CALL ARGS
CALL ICOPY
```

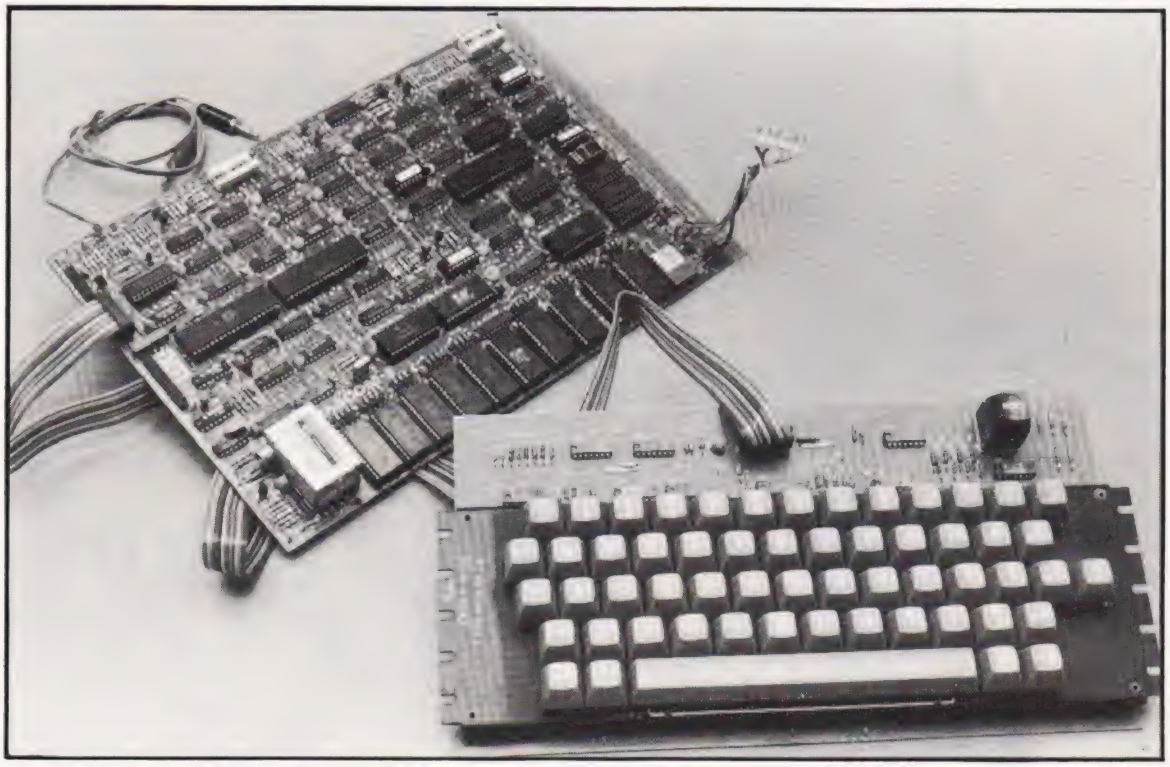
NOPs have been placed in the original for those without assemblers.

Note For One Owners

A friend has tried this on his NASCOM 1 and the modifications have proved successful except that the NASCOM 1 leaves a cursor on the screen after printing a line number. So assembly line 0DD0 should be changed to 'CP 5F' instead of 'CP 20'.

```
0010  0C80                    %
0020  0C80                    %
0030  0C80                    %@@@@@@@@@@@@@@@@@@@@
0040  0C80                    %
0050  0C80                    %          NASCOM BASIC RENUMBER
0060  0C80                    %
0070  0C80                    %              PROGRAMMED BY
0080  0C80                    %
0090  0C80                    %              A.S.WATKINS
00A0  0C80                    %
00B0  0C80                    %
00C0  0C80                    %
00D0  0C80                    %
00E0  0C80                    %
00F0  0C80                    %
0100  0C80                    %@@@@@@@@@@@@@@@@@@@@
0110  0C80                    %
0120  0C80                    %
0130  0C80                    % NASYS DATA
0140  0C80                    %
0150  0018                    SCAL      EQU 18
0160  0030                    ROUT      EQU 30
0170  001B                    ESC       EQU 1B
0180  0017                    CH        EQU 17
0190  0C0C                    ARG1      EQU 0C0C
01A0  0C0E                    ARG2      EQU 0C0E
01B0  0C10                    ARG3      EQU 0C10
01C0  0C29                    CURSOR    EQU 0C29
01D0  0060                    ZARGS     EQU 60
01E0  0043                    ZICOPY    EQU 43
01F0  0C80                    %
0200  0C80                    % BASIC DATA
0210  0C80                    %
0220  0088                    GOTO      EQU 88
0230  008B                    RESTOR    EQU 8B
0240  008C                    GOSUB     EQU 8C
0250  008E                    REM       EQU 8E
0260  00A9                    THEN      EQU 0A9
0270  10D6                    TOP       EQU 10D6
0280  105E                    START     EQU 105E
0290  0C80                    %
02A0  0C80                    % BASIC SUBROUTINES
02B0  0C80                    %
02C0  E836                    CHKNUM    EQU 0E836
02D0  E9A5                    ATOH      EQU 0E9A5
02E0  E68A                    CPHLDE    EQU 0E68A
02F0  F9AD                    PHTOA     EQU 0F9AD
0300  FFFD                    WSTART    EQU 0FFFD
0310  0C80                    %
0320  0C80                    % ENTRY SET UP USER STACK
0330  0C80                    %
0340  0C80  31 00 10                    LD  SP 1000
0350  0C83                    %
0360  0C83                    % START AT BOTTOM OF BASIC PROG
0370  0C83                    % LOOK FOR GOTO,GOSUB
0380  0C83                    % THEN+NO.,RESTORE+NO.
0390  0C83                    % IGNORE ANYTHING IN QUOTES
03A0  0C83                    % AND REM STATEMENTS
03B0  0C83                    %
03C0  0C83  2A 5E 10          NEXTL     LD HL (START)
03D0  0C86  22 E4 0D                    LD (ACURR) HL
03E0  0C89  CD D6 0C                    CALL TSTEND
03F0  0C8C  28 4F                       JR Z NEWNUM
0400  0C8E  ED 53 E2 0D                 LD (NXTLIN) DE
0410  0C92  23                          INC HL
0420  0C93  23                          INC HL
0430  0C94  01 04 00                    LD BC 4
0440  0C97  7E                LDCHR     LD A (HL)
0450  0C98  03                          INC BC
0460  0C99  B7                          OR A
0470  0C9A  23                LINEND    INC HL
0480  0C9B  28 E9                       JR Z NEXTL
0490  0C9D  2B                          DEC HL
04A0  0C9E  1E 22                       LD E 22
04B0  0CA0  FE 22                       CP 22
```

NASCOM RE-NUMBER



The NASCOM 2 computer running NAS SYS.

```
04C0  0CA2  28 06              JR Z BUMP
04D0  0CA4  FE 8E              CP REM
04E0  0CA6  20 0B              JR NZ NOTR22
04F0  0CA8  1E 3A              LD E ':'
0500  0CAA  23          BUMP   INC HL
0510  0CAB  03                 INC BC
0520  0CAC  7E                 LD A (HL)
0530  0CAD  B7                 OR A
0540  0CAE  28 EA              JR Z LINEND
0550  0CB0  BB                 CP E
0560  0CB1  20 F7              JR NZ BUMP
0570  0CB3  FE 88       NOTR22 CP GOTO
0580  0CB5  28 15              JR Z COMAND
0590  0CB7  FE 8C              CP GOSUB
05A0  0CB9  28 11              JR Z COMAND
05B0  0CBB  FE A9              CP THEN
05C0  0CBD  28 04              JR Z CHKDEC
05D0  0CBF  FE 8B              CP RESTOR
05E0  0CC1  20 10              JR NZ NXTCHR
05F0  0CC3  E5          CHKDEC PUSH HL
0600  0CC4  CD 36 E8           CALL CHKNUM
0610  0CC7  E1                 POP HL
0620  0CC8  38 02              JR C COMAND
0630  0CCA  18 07              JR NXTCHR
0640  0CCC  C5          COMAND PUSH BC
0650  0CCD  E5                 PUSH HL
0660  0CCE  CD 08 0D           CALL VALCOM
0670  0CD1  E1                 POP HL
0680  0CD2  C1                 POP BC
0690  0CD3  23          NXTCHR INC HL
06A0  0CD4  18 C1              JR LDCHR
06B0  0CD6              %
06C0  0CD6              % DE LOADED WITH ADDRESS OF
06D0  0CD6              % NEXT BASIC LINE
06E0  0CD6              % DE THEN TESTED IF Z END
06F0  0CD6              % OF BASIC PROG
0700  0CD6              %
0710  0CD6  5E          TSTEND LD E (HL)
0720  0CD7  23                 INC HL
0730  0CD8  56                 LD D (HL)
0740  0CD9  23                 INC HL
0750  0CDA  7B                 LD A E
0760  0CDB  B2                 OR D
0770  0CDC  C9                 RET
0780  0CDD              %
0790  0CDD              % INSERT NEW LINE NOS.
07A0  0CDD              % JUMP TO BASIC WHEN DONE
07B0  0CDD              %
07C0  0CDD  CD F0 0C    NEWNUM CALL NUMSET
07D0  0CE0  CD D6 0C    NXTNUM CALL TSTEND
07E0  0CE3  CA FD FF           JP Z WSTART
07F0  0CE6  D5                 PUSH DE
0800  0CE7  CD FA 0C           CALL INCNUM
0810  0CEA  73                 LD (HL) E
0820  0CEB  23                 INC HL
0830  0CEC  72                 LD (HL) D
0840  0CED  E1                 POP HL
0850  0CEE  18 F0              JR NXTNUM
0860  0CF0              %
0870  0CF0              % ZERO LINNUM HL TO
0880  0CF0              % BASIC PROG BOTTOM
0890  0CF0              %
08A0  0CF0  21 00 00    NUMSET LD HL 0
08B0  0CF3  22 E6 0D           LD (LINNUM) HL
08C0  0CF6  2A 5E 10           LD HL (STAT)
08D0  0CF9  C9                 RET
08E0  0CFA              %
08F0  0CFA              % INCREMENT LINNUM BY 10
0900  0CFA              %
0910  0CFA  E5          INCNUM PUSH HL
0920  0CFB  11 0A 00           LD DE 0A
0930  0CFE  2A E6 0D           LD HL (LINNUM)
0940  0D01  19                 ADD HL DE
0950  0D02  22 E6 0D           LD (LINNUM) HL
0960  0D05  EB                 EX DE HL
0970  0D06  E1                 POP HL
0980  0D07  C9                 RET
0990  0D08              %
09A0  0D08              % GOTO GOSUB OR THEN FOUND
09B0  0D08              % COPY LINE SO FAR TO BUFFER
09C0  0D08              % IF DATA FOLLOWING COMMAND NOT
09D0  0D08              % ASCII DECIMAL THEN ERROR SO MAKE
09E0  0D08              % LINE NO. ZERO
09F0  0D08              %
0A00  0D08  11 E8 0D    VALCOM LD DE BUFF1
0A10  0D0B  2A E4 0D           LD HL (ACURR)
0A20  0D0E  ED B0              LDIR
0A30  0D10  7E                 LD A(HL)
0A40  0D11  FE 20              CP 20
0A50  0D13  20 02              JR NZ NOTSPC
0A60  0D15  12                 LD (DE) A
0A70  0D16  13                 INC DE
```

NASCOM RE-NUMBER

```
0A80 0D17 D5          NOTSPC  PUSH DE
0A90 0D18 2B                  DEC HL
0AA0 0D19 CD 36 E8    ONLINE  CALL CHKNUM
0AB0 0D1C 30 23               JR NC ZLINE0
0AC0 0D1E             %
0AD0 0D1E             % CONVERT LINE NO.
0AE0 0D1E             % TO HEX IN DE
0AF0 0D1E             %
0B00 0D1E CD A5 E9            CALL ATOH
0B10 0D21 E5                  PUSH HL
0B20 0D22 D5                  PUSH DE
0B30 0D23             %
0B40 0D23             % COUNT THRU BASIC PROG
0B50 0D23             % LOOKING FOR LINE NO.
0B60 0D23             % IF NOT THERE MAKE IT ZERO
0B70 0D23             %
0B80 0D23 CD F0 0C            CALL NUMSET
0B90 0D26 CD D6 0C    FNDLIN  CALL TSTEND
0BA0 0D29 28 18               JR Z LINE0
0BB0 0D2B D5          NOTEND  PUSH DE
0BC0 0D2C C1                  POP BC
0BD0 0D2D CD FA 0C            CALL INCNUM
0BE0 0D30 7E                  LD A (HL)
0BF0 0D31 23                  INC HL
0C00 0D32 66                  LD H (HL)
0C10 0D33 6F                  LD L A
0C20 0D34 D1                  POP DE
0C30 0D35 D5                  PUSH DE
0C40 0D36 CD 8A E6            CALL CPHLDE
0C50 0D39 28 0B               JR Z GOTLIN
0C60 0D3B 30 06               JR NC LINE0
0C70 0D3D C5                  PUSH BC
0C80 0D3E E1                  POP HL
0C90 0D3F 18 E5               JR FNDLIN
0CA0 0D41 E5          ZLINE0  PUSH HL
0CB0 0D42 D5                  PUSH DE
0CC0 0D43 CD F0 0C    LINE0   CALL NUMSET
0CD0 0D46             %
0CE0 0D46             % CONVERT HEX LINE NO. IN HL
0CF0 0D46             % TO ASCII AND PRINT ON SCREEN
0D00 0D46             % COPY TO BUFFER
0D10 0D46             %
0D20 0D46 D1          GOTLIN  POP DE
0D30 0D47 3E 1B               LD A ESC
0D40 0D49 F7                  RST ROUT
0D50 0D4A 2A E6 0D            LD HL (LINNUM)
0D60 0D4D CD AD F9            CALL PHTOA
0D70 0D50 3E 17               LD A CH
0D80 0D52 F7                  RST ROUT
0D90 0D53 ED 5B 29 0C         LD DE (CURSOR)
0DA0 0D57 E1                  POP HL
0DB0 0D58 E3                  EX (SP) HL
0DC0 0D59 1A          NXTVID  LD A (DE)
0DD0 0D5A FE 20               CP 20
0DE0 0D5C 28 05               JR Z NUMDON
0DF0 0D5E 77                  LD (DL) A
0E00 0D5F 23                  INC HL
0E10 0D60 13                  INC DE
0E20 0D61 18 F6               JR NXTVID
0E30 0D63             %
0E40 0D63             % IF NEXT CHAR COMMA THEN MUST BE
0E50 0D63             % ON GOTO/GOSUB
0E60 0D63             % SO DO THAT NO. TOO.
0E70 0D63             %
0E80 0D63 D1          NUMDON  POP DE
0E90 0D64 EB                  EX DE HL
0EA0 0D65 7E                  LD A (HL)
0EB0 0D66 FE 2C               CP 2C
0EC0 0D68 20 05               JR NZ SHIFT
0ED0 0D6A 12                  LD (DE) A
0EE0 0D6B 13                  INC DE
0EF0 0D6C D5                  PUSH DE
0F00 0D6D 18 AA               JR ONLINE
0F10 0D6F             %
0F20 0D6F             % MOVE REST OF LINE INTO BUFFER
0F30 0D6F             %
0F40 0D6F 7E          SHIFT   LD A (HL)
0F50 0D70 23                  INC HL
0F60 0D71 12                  LD (DE) A
0F70 0D72 13                  INC DE
0F80 0D73 B7                  OR A
0F90 0D74 20 F9               JR NZ SHIFT
0FA0 0D76             %
0FB0 0D76             % LENGTH OF NEW LINE
0FC0 0D76             %
0FD0 0D76 21 E8 0D            LD HL BUFF1
0FE0 0D79 EB                  EX DE HL
0FF0 0D7A ED 52               SBC HL DE
1000 0D7C E5                  PUSH HL
1010 0D7D             %
1020 0D7D             % LENGTH OF OLD LINE
1030 0D7D             %
1040 0D7D ED 5B E4 0D         LD DE (ACURR)
1050 0D81 2A E2 0D            LD HL (NXTLIN)
1060 0D84 B7                  OR A
1070 0D85 ED 52               SBC HL DE
1080 0D87 D1                  POP DE
1090 0D88 D5                  PUSH DE
10A0 0D89             %
10B0 0D89             % DIFFERENCE
10C0 0D89             %
10D0 0D89 B7                  OR A
10E0 0D8A ED 52               SBC HL DE
10F0 0D8C 28 49               JR Z INSLIN
1100 0D8E             %
1110 0D8E             % IF LINES DIFFERENT SHIFT
1120 0D8E             % REST OF BASIC PROG
1130 0D8E             %
1140 0D8E ED 5B E2 0D         LD DE (NXTLIN)
1150 0D92 EB                  EX DE HL
1160 0D93 E5                  PUSH HL
1170 0D94 22 0C 0C            LD (ARG1) HL
1180 0D97 B7                  OR A
1190 0D98 ED 52               SBC HL DE
11A0 0D9A 22 0E 0C            LD (ARG2) HL
11B0 0D9D 22 E2 0D            LD (NXTLIN) HL
11C0 0DA0 2A D6 10            LD HL (TOP)
11D0 0DA3 E5                  PUSH HL
11E0 0DA4 B7                  OR A
11F0 0DA5 ED 52               SBC HL DE
1200 0DA7 22 D6 10            LD (TOP) HL
1210 0DAA E1                  POP HL
1220 0DAB D1                  POP DE
1230 0DAC B7                  OR A
1240 0DAD ED 52               SBC HL DE
1250 0DAF 22 10 0C            LD (ARG3) HL
1260 0DB2 DF                  RST SCAL
1270 0DB3 60                  DEFB ZARGS
1280 0DB4 00                  NOP
1290 0DB5 DF                  RST SCAL
12A0 0DB6 43                  DEFB ZICOPY
12B0 0DB7 00                  NOP
12C0 0DB8 CD D2 0D            CALL INS2
12D0 0DBB             %
12E0 0DBB             % INSERT NEW LINE START
12F0 0DBB             % ADDRESSES
1300 0DBB             %
1310 0DBB 2A E4 0D            LD HL (ACURR)
1320 0DBE E5          NXTADD  PUSH HL
1330 0DBF CD D6 0C            CALL TSTEND
1340 0DC2 D1                  POP DE
1350 0DC3 C8                  RET Z
1360 0DC4 23                  INC HL
1370 0DC5 23                  INC HL
1380 0DC6 7E          FINDT   LD A (HL)
1390 0DC7 23                  INC HL
13A0 0DC8 B7                  OR A
13B0 0DC9 20 FB               JR NZ FINDT
13C0 0DCB 7D                  LD A L
13D0 0DCC 12                  LD (DE) A
13E0 0DCD 13                  INC DE
13F0 0DCE 7C                  LD A H
1400 0DCF 12                  LD (DE) A
1410 0DD0 18 EC               JR NXTADD
1420 0DD2             %
1430 0DD2             % INSERT NEW LINE
1440 0DD2             %
1450 0DD2 E1          INS2    POP HL
1460 0DD3 C1                  POP BC
1470 0DD4 E5                  PUSH HL
1480 0DD5 18 01               JR INS3
1490 0DD7 C1          INSLIN  POP BC
14A0 0DD8 21 E8 0D    INS3    LD HL BUFF1
14B0 0DDB ED 5B E4 0D         LD DE (ACURR)
14C0 0DDF ED B0               LDIR
14D0 0DE1 C9                  RET
14F0 0DE2 00 00       NXTLIN  DEFS 2
14F0 0DE4 00 00       ACURR   DEFS 2
1500 0DE6 00 00       LINNUM  DEFS 2
1510 0DE8             BUFF1   EQU £
```

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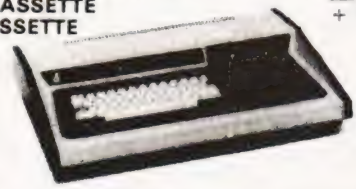

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PROGRAMMER

From the land of Longhorn comes an aid to all micro users who can't get fluent in Hex.

Can you work out the sum of two four-digit Hex numbers in the time it takes to read this sentence? If you're anything like me you'll write them down, think a bit and, probably, still get it wrong at the first attempt. Octal I can manage, but Hex still gets my brain into an overheated state. The usual solution to these mental nightmares is to resort to a set of tables, or to write a nice little program to do it all for you, but, for a couple of years now, there's been an alternative solution. Called the TI Programmer it looks and acts just like an ordinary, slightly old fashioned calculator but it has a very, very powerful plus, what else could you expect from Texas Instruments?

Functioning Digits

As well as acting as a conventional, decimal, four-function calculator with memory and constant, the device will work equally well in both octal (base 8) and Hex (base 16) arithmetic . It can even cope with a mix of all or any of the three, because as soon as you select a new base it converts all the currently displayed information to the new base. Indeed, any number stored in the memory, or as a constant, is converted as well so you can't muddle the machine.

To obtain negative numbers for Hex and octal calculations the device uses two's complement arithmetic, just like your micro. One's complement is also available, this is used as the NOT in logical analysis.

Although the Programmer can cater for decimal fractions, (floating points to you) it cannot perform fractional Hex or octal, one has to keep track mentally or choose a suitable multiplier and remember where the point went to.

Just as numbers can be manipulated in the accumulator of a microprocessor so can numbers in the "accumulator" of the Programmer. You can shift Hex and octal numbers both left and right and perform logical AND, OR, XOR and NOT operations on the binary bit pattern stored. The keytops of digits 0 to A are labelled with their binary bit pattern, a useful aide memoir.

Mind Of Its Own

As well as being exceedingly versatile the Programmer is by no means easily fooled, especially by clumsy digits. It has the infuriating habit of totally ignoring you if you are trying to enter, for example, Hex when in decimal mode. One doesn't like to admit mistakes, especially to a little black box!

The Programmer is equipped as standard with a re-chargeable battery pack and these are protected from forgetful users by a display and power turn-off circuit. After about a minute of inactivity the display is replaced by a running dot and, after a further ten minutes or so it shuts off completely. One can recover from the blanked stage by pressing any key, the equals is probably a nice safe bet.

As an example of the thought that has gone into the Programmer one can disable this turn-off, ideal when using the charger as an adaptor, by pressing "0.=" at the same time. When you turn off, the device reverts to the normal mode.

The TI Programmer with a close-up look at its clearly labelled keyboard.

The Programmer is supplied with the re-chargeable battery, a carrying case, manual and the charger/adaptor. The documentation is adequate, there is not, after all, too much to explain and the use of examples throughout is helpful.

Summary

Because of the increase in the size of its potential market place it is initially surprising to find that the price tag on the Programmer is unchanged from its launch, some two years ago. However, inflation has risen since then, so the price, in real terms at least, has probably dropped in proportion to the size of the market. At around £50 it still represents reasonable value for money and is certainly a recommended item for small computer owners who are going to embark upon serious programming.

Like all labour saving gadgets it proves indispensible once used. One suspects, however, that the Japanese might soon wake up to the fact that they are missing out on a slice of the market and then the prices will come right down, solely because of.the two year technology gap.

A summary of the machine's salient features is given in Table 1 but the best way to assess its value is to try it and most good calculator stockists should be able to supply it.

Conversion between any of three bases (decimal, octal & Hex)
Full floating decimal calculations
Independant memory with summation
Fifteen sets of parentheses possible
Logical operations at bit level on Hex and octal numbers
Constant function
Bit shift on both Hex and octal numbers
Auto power saving features with optional cancel.

Table 1. Main features of the TI Programmer.

J.D. Lee and T.D. Lee

A macabre look at a classic classroom experiment.

Newton's Law of Cooling states that the rate at which a body cools in a draught is directly proportional to the excess temperature. That is, the temperature difference between the body and its surroundings. Whilst this should be well known by Physicists, who regard any object as a body, it is less frequently known by others.

To illustrate this law an example is chosen which is likely to be remembered by a wide variety of morbid users. The example deals with bodies — dead bodies! The way in which the time of death of a body may be established from temperature readings will be described. This will be immensly useful to potential pathologists and aspiring assassins, and a computer program is provided for the benefit of non-physicists.

Background

When alive, a human body is closely regulated to maintain a temperature of 98.4°F (approximately 37°C) except during illness such as a fever. When a person dies, their body is no longer maintained at this temperature and consequently it gradually cools towards room temperature. For a physicist's type of body, for example a bar of metal, the rate at which the heat is connected along the bar is given by:

$$-\frac{dQ}{dt} = K A \frac{\Delta\theta}{\Delta x} \qquad (1)$$

where $-dQ/dt$ is the rate of heat loss with time,
K is the thermal conductivity of the metal,
A is the (cross sectional) area through which heat travels,
$\Delta\theta$ is the temperature difference between the two ends,
Δx is the distance between the two ends.

For a human body, the heat is conducted from the centre of the body, through the skin and clothes to the air. In a strong draught the warmer air is immediately blown away. The constant K in equation (1) represents the thermal conductivity of skin and clothes combined, A is the surface area of the body and Δx is the thickness of skin and clothes. Not only are these three terms unknown, they also vary depending on the physique and state of dress of the particular body. Nevertheless they are constant for any one body. Thus:-

$$-\frac{dQ}{dt} \text{ is proportional to } \Delta\theta \qquad (2)$$

Moreover the heat content, Q, of a body is its heat capacity multiplied by its absolute temperature θ. Thus:-

Q is proportional to θ

hence

$$-\frac{dQ}{dt} \text{ is proportional to } -\frac{d\theta}{dt} \qquad (3)$$

Combining equations (2) and (3) shows that the rate of cooling $-d\theta/dt$ of the body is proportional to the excess temperature $\Delta\theta$. Newton arrived at the same conclusion about three hundred years ago!

Programming The Macabre!

Mathematically it can be shown that the body temperature falls exponentially towards the air temperature. If a body temperature reading is taken at an unknown time after death, it is not possible to calculate when the body was at 98.4°F since the proportionality constant is not known. However if two temperature readings are taken with a known time interval between them, then the time of death maay be calculated.

$$\text{Time of death} = \frac{\ln\left[\dfrac{\text{first body temperature} - \text{air temperature}}{\text{body temperature} - \text{air temperature}}\right]}{\ln\left[\dfrac{\text{second body temperature} - \text{air temperature}}{\text{body temperature} - \text{air temperature}}\right]} * \text{time between readings}$$

The time of death thus calculated is given as the time before the first temperature reading was taken. Unfortunately Newton's Law of Cooling only applies in a strong constant draught, which would be the case in an exposed windy location, or in an air conditioned building. In still air, the air warms up and natural convection occurs. The rate of cooling $-d\theta/dt$ is given by

$$-\frac{d\theta}{dt} \text{ is proportion to } \Delta\theta^{5/4}$$

rather than

$$-\frac{d\theta}{dt} \text{ is proportional to } \Delta\theta$$

as given by Newton's Law of Cooling. The time of death may be calculated.

$$\text{Time of death} = \frac{\ln\left[\dfrac{(\text{first body temperature} - \text{air temperature})^{-1/4}}{-(\text{body temperature} - \text{air temperature})^{-1/4}}\right]}{\ln\left[\dfrac{(\text{second body temperature} - \text{air temperature})^{-1/4}}{-(\text{first body temperature} - \text{air temperature})^{-1/4}}\right]} * \text{time between readings}$$

The Five-Fourths Law of Cooling was determined empirically by Dulong and Petit, and justified theoretically by Lorentz in 1881. Users who are surprised at their results are referred to those mentioned above or the Newton himself!

A BASIC program is provided, written in a most elementary sub-set of the language, which should facilitate its implementation on a wide variety of computers. A sample run is also provided.

Description Of The Program

The program first asks if the user requires full instructions. An answer of YES or NO is expected and all other responses are rejected. Depending on the answer explicit or shortened messages are printed during the first run. Regardless of the answer, short messages are always given on the second and subsequent runs.

The user is invited to choose whether to use the Celsius or Fahrenheit temperature scales. The reply is checked and only C or F are allowed.

In turn the air temperature, the first body temperature and the second body temperature are requested. Checks are performed to ensure that the numbers entered are reasonable. Warning messages are printed if the values are out of range and the user has to re-type an acceptable value. Finally the user is asked for the time the interval between the temperature

readings. This too is checked, and must be positive and less than five hours.

The time of death is calculated using Newton's Law of Cooling (in a draught), and the Five-Fourths Law.

An explanation of the methods is provided on request and finally the user is asked if he would like another run.

List Of Variables

The strings Q$ and I$ are used for the replies to questions and whether full instructions are required respectively. These are DIMensioned in line 10 so that I$ may contain up to three characters and Q$ up to ten characters. For a number of versions of BASIC strings are handled in a different way and DIM I$ (3) reserves space for four strings I$(0), I$(1), I$(2) and I$(3). For such implementations of BASIC line 10 should be omitted.

A Air temperature surroundings
B Body temperature (when alive)
D Death time in minutes before first reading
F First temperature reading made on corpse
S Second temperature reading made on corpse
T Time in minutes between the two readings

```
10 DIM I$(3), Q$(10)
20 PRINT TAB(30); "Time of Death"
30 PRINT TAB(30); "============"
40 PRINT
50 PRINT "Would you like FULL instructions"
60 GOSUB 940
70 LET I$ = Q$
80 IF I$ = "NO" THEN 160
90 PRINT
100 PRINT "This program calculates how long a person has been dead"
110 PRINT "from two body temperature readings, the time between the"
120 PRINT "readings and the surrounding air temperature.  Newton's"
130 PRINT "Law of Cooling is assumed if the body is in a draught"
140 PRINT "otherwise the Five Fourths Law of Natural Convection is used"
150 PRINT
160 PRINT "Would you like to work in degrees Celcius or Fahrenheit"
170 IF I$ = "NO" THEN 190
180 PRINT "Type C or F and press RETURN"
190 INPUT Q$
200 REM *** SET NORMAL BODY TEMPERATURE B
210 LET B = 98.6
220 IF Q$ = "F" THEN 270
230 LET B = 37
240 IF Q$ = "C" THEN 270
250 PRINT "Reply '"; Q$; "' not understood. Re-";
260 GOTO 180
270 PRINT "Type the air temperature"
280 INPUT A
290 IF (A + 40) * (A - B) < 0 THEN 330
300 PRINT "The air temperature must be between -40 degrees"
310 PRINT "and"; B; " degrees. Re-";
320 GOTO 270
330 PRINT "Type the first body temperature"
340 INPUT F
350 IF (F - B) * (F - A) < 0 THEN 390
360 PRINT "The first body temperature must be between"; B; " and"; A;
370 PRINT "degrees.  Re-";
380 GOTO 330
390 PRINT "Type the second body temperature"
400 INPUT S
410 IF (S - F) * (S - A) < 0 THEN 450
420 PRINT "The second body temperature must be between"; F; " and"; A;
430 PRINT "degrees.  Re-";
440 GOTO 390
450 LET S = S - A
460 LET F = F - A
470 LET B = B - A
480 PRINT "Type the time in minutes between temperature readings"
490 IF I$ = "NO" THEN 510
500 PRINT "Then press RETURN"
510 INPUT T
520 IF T * (T - 300) < 0 THEN 570
530 PRINT "The time must be between 0 and 300 minutes (five hours)"
540 PRINT "Re-";
550 GOTO 480
560 REM *** CALCULATE TIME OF DEATH USING NEWTON'S LAW OF COOLING
570 LET D = INT(LOG(F / B) * T / LOG(S / F) + 0.5)
580 PRINT "Assuming that the body was in a strong constant wind,"
590 PRINT "the person died";
600 IF D < 60 THEN 620
610 PRINT INT(D / 60); " hours and";
620 PRINT D - 60 * INT(D / 60); " minutes before the first reading."
630 PRINT
640 REM CALCULATE TIME OF DEATH USING FIVE FOURTHS LAW
650 LET D = INT((B^(-.25) - F^(-.25)) * T / (F^(-.25) - S^(-.25)) + 0.5)
660 PRINT "If the body was in still air then a better estimate is"
670 IF D < 60 THEN 690
680 PRINT INT(D / 60); " hours and";
690 PRINT D - 60 * INT(D / 60); " minutes before the first reading."
700 PRINT
710 PRINT "Would you like an explanation of the methods"
720 GOSUB 930
730 IF Q$ = "NO" THEN 850
740 PRINT
750 PRINT "The first method uses Newton's Law of Cooling which assumes"
760 PRINT "that the rate of cooling of a body is proportional to the"
770 PRINT "temperature difference between the body and the atmosphere."
780 PRINT "Newton's Law applies if the body is in a strong constant"
790 PRINT "draught eg. an air conditioned room.  Such cooling is called"
800 PRINT "FORCED convection.  If the atmosphere is still Newton's Law"
810 PRINT "does not apply and the heat loss is proportional to the"
820 PRINT "excess temperature to the power 1.25.  This is called the"
830 PRINT "Five Fourths Law for NATURAL convection and gives rise to"
840 PRINT "the second result."
850 PRINT
860 PRINT "Would you like another run"
870 GOSUB 930
880 LET I$ = "NO"
890 IF Q$ = "YES" THEN 150
900 PRINT "You are finished - Rigor Mortis has set in"
910 STOP
920 REM *** SUBROUTINE TO SORT OUT YES / NO ANSWERS
930 IF I$ = "NO" THEN 950
940 PRINT "Type YES or NO and press RETURN"
950 INPUT Q$
960 IF Q$ = "YES" THEN 1000
970 IF Q$ = "NO" THEN 1000
980 PRINT "Reply '"; Q$; "' not understood. Re-";
990 GOTO 940
1000 RETURN
1010 END
```

The standard BASIC program listing.

```
                         Time of Death
                         =============
Would you like FULL instructions
Type YES or NO and press RETURN
? YES

This program calculates how long a person has been dead
from two body temperature readings, the time between the
readings and the surrounding air temperature.  Newton's
Law of Cooling is assumed if the body is in a draught
otherwise the Five Fourths Law of Natural Convection is used

Would you like to work in degrees Celcius or Fahrenheit
Type C or F and press RETURN
? C
Type the air temperature
? 6
Type the first body temperature
? 25
Type the second body temperature
? 14
Type the time in minutes between temperature readings
Then press RETURN
? 45
Assuming that the body was in a strong constant wind,
the person died 25  minutes before the first reading.

If the body was in still air then a better estimate is
21  minutes before the first reading.

Would you like an explanation of the methods
Type YES or NO and press RETURN
? YES

The first method uses Newton's Law of Cooling which assumes
that the rate of cooling of a body is proportional to the
temperature difference between the body and the atmosphere.
Newton's Law applies if the body is in a strong constant
draught eg. an air conditioned room.  Such cooling is called
FORCED convection.  If the atmosphere is still Newton's Law
does not apply and the heat loss is proportional to the
excess temperature to the power 1.25.  This is called the
Five Fourths Law for NATURAL convection and gives rise to
the second result.

Would you like another run
Type YES or NO and press RETURN
? NO
You are finisned - Rigor Mortis has set in

OK,
```

A sample run of the program.

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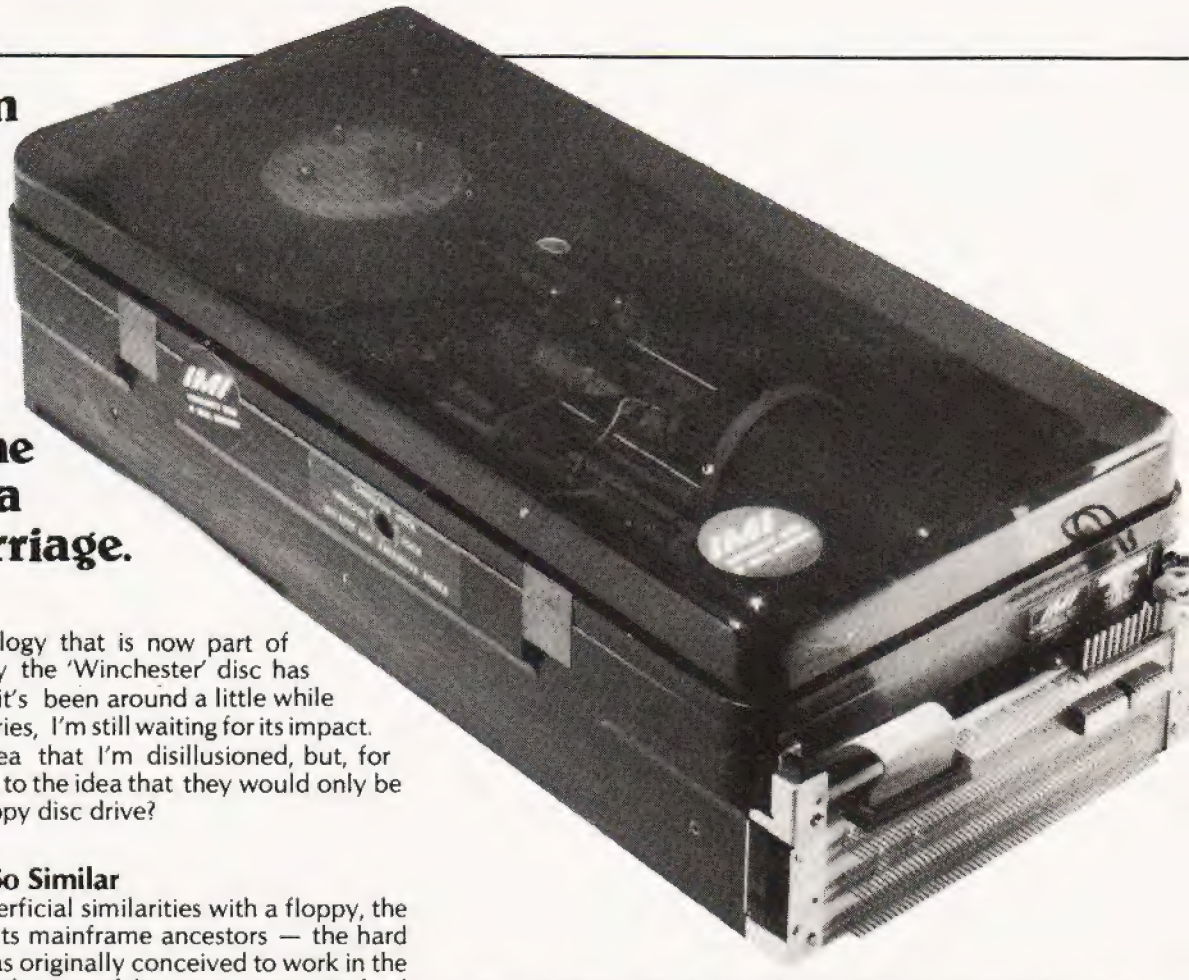
CT G2

John Robinson

The medium of the future? Hard discs have been around for a while but Winnie is the product of a curious marriage.



Utilising a technology that is now part of computer history the 'Winchester' disc has arrived. In fact, it's been around a little while and, like bubble memories, I'm still waiting for its impact. Please don't get the idea that I'm disillusioned, but, for starters, what happened to the idea that they would only be twice the price of a floppy disc drive?

Similar But Not So Similar

While there are superficial similarities with a floppy, the technology owes all to its mainframe ancestors — the hard disc units. The floppy was originally conceived to work in the "off-line room", that is in the area of data preparation. To feed the large computers it is necessary to prepare data in a machine readable form. On the traditional computers there were usually only a few ports through which you fed data. Using any one of these ports tied up the computer completely, and so data transfer had to be extremely fast or else things would grind to a halt.

Punched Paper

The early input devices were fed with paper tape punched with holes. These punched documents were in the form of continuous paper tape or punched cards. The punching machines varied from simple hand punches to large desk sized machines with data validation facilities. Speeding up the input of these forms of data to the mainframe produced some truly miraculous machines. They handled tape and cards at amazing speeds, and occasionally turned them into confetti at slightly more amazing speeds. In other words, there is a limit to the rate of data input with punched paper!

Magnetic Tape

Magnetic tape replaced punched paper in large data preparation applications, but its expense and its frailty have always made it an uncomfortable medium to work with.

The spectre of incompatibility has constantly haunted the data preparation rooms of computerised companies. Incompatibility is the problem whereby you may spend hours preparing a tape on your data preparation tape drive, to find that the tape drive on your mainframe cannot read it! The awkward problem of incompatibility is that the magnetic tape drive that writes the data on the tape will be able to read its own writing but no other tape drive will be able to. The tape on its reel is also a difficult and heavy item to ship around. Supposing, perhaps, you have to send it from London to Glasgow by post?

The floppy diskette provides a stark contrast to the drawbacks of its predecessors. It has been known to be shipped unprotected in an envelope through the mail and still be readable (Not advisable! Ed.) This was a well publicised experiment in its early days.

The machines on which floppy diskettes are prepared need only be table-top in size and a feature of the floppy is the general lack of compatibility problems. Most of the larger computers can be fitted with a diskette drive to take the data into its bigger and much faster backup stores.

Enter Winnie

It is at this point that we discover just where the 'Winchester' came from. The bigger and faster backup storage on the large computer is likely to be a floating head disc drive. The rigid-disc drive is used for holding the large amount of data that the computer will require, and needs to get very quickly.

A common application nowadays is for the rigid-disc drive to hold programs for multiple job operations. A large system may be attempting to run many big programs simultaneously, the total memory size available being considerably less than the size of all the programs added together. It will run a few of them together and occasionally put some onto a disc drive and bring some others into memory to get their share of processor time. This is called "Virtual Storage" because it doesn't actually exist. All this must happen incredibly quickly or the processor will spend too much time waiting for the disc to send the programs in or take them out again.

Another problem is that of massive file sizes. A list of customer accounts may be several millions of bytes long. It is clearly impossible to hold them all in the somewhat expensive main memory of the computer. Even with semiconductor memories (RAM), at present prices this would be wasteful.

With the older forms of memory such as core memory the cost would be totally prohibitive.

Rigor Mortis Sets In

The rigid disk was the culmination of numerous weird and wonderful attempts to provide the computer with a medium speed, very high volume storage system at a reasonable price. High speed must be traded off against cost and this has been done very successfully in the case of the rigid-disc drive.

Modern versions can (from a single drive) provide any of 700 million bytes within 40 mS (40 one-thousandths of a second). The rigid-disc drive consists of a metal disc coated with magnetic material (Fig. 1). As in the floppy disc drive, the heads are driven across the spinning surface of the disc by some mechanism. This mechanism must be capable of holding the head precisely over one track while the head reads or writes the data on that (invisible) track.

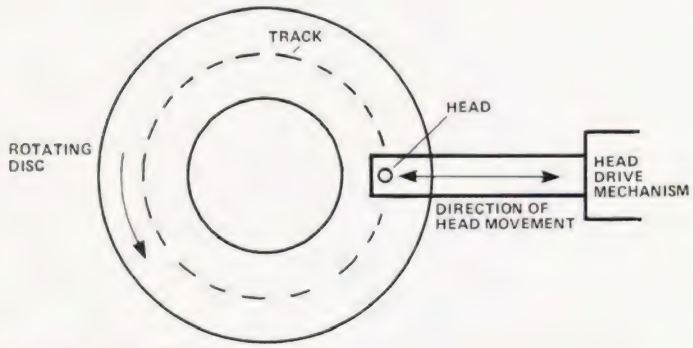


Fig 1. Using a single head which tracks across a fixed platter greatly increases the storage capacity.

The track may be divided up into sectors for the convenience of both the hardware and software. The head drive mechanism must also be able to move onto this track repeatedly and accurately. Many hundreds of tracks can exist across the disc surface and the drive may have many discs mounted one above each other. These discs are on a common spindle and have one head for each surface, these share a common head drive mechanism (Fig.2).

The major difference to a floppy is that despite the considerable pressure that is applied to the head towards the disc surface there is no contact. Therefore there is no wear and tear on the disc surface.

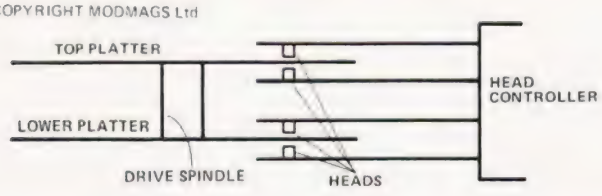


Fig 2. Stacking platters is a technique borrowed from the mainframe industry. Both sides of the media can be used, thus doubling the capacity without having to turn the disc over.

Floating Away

The technology depends on a dynamic phenomenon whereby a rotating disc, plentifully supplied with air to its surfaces, develops a "skin" of air on these surfaces. Attempts to press a suitably shaped head closer than a few hundred microns to the actual surface of the disc will meet with a considerable resistance from this film of air.

The distance is of critical importance and depends upon the speed of rotation, the nature of the disc surface, the size of the head, and the aerodynmaic properties of its shape. The head is referred to as 'flying' for obvious reasons. This either reads information from the disc surface or writes it onto the disc surface, and the closer it can fly the more closely packed the information can be recorded onto one disc.

Unfortunately, the closer the head flies the more likely it is to accidentally touch the disc surface and, at 2400 RPM, it acts like a lathe cutting head. This is referred to as a disc "crash" in the industry. No matter how carefully the disc is designed all it takes is a minute particle to upset the dynamic relationship of the head to the disc surface and "in she ploughs". Even a puff of cigarette smoke contains particles of sufficient size!

The answer to this problem is to seal the disc and its associated mechanisms into its own closed-loop filtered air system. This is what has been done on the Winchester drive.

Fixed In

The disc is not removable as in some of its predecessors and this allows a much more precise relationship to the heads. Thus the tracks can be recorded closer together giving another significant increase in data density.

Improvements in the oxide coating on the surface of the disc have also permitted the increased density of recording. Several hundred tracks per inch are now possible with around 8000 bits per inch (BPI).

Good, old-fashioned magnetic tape. 2400 feet at 6250 BPI equals an awful lot of information.

MINNIE WINNIE WHO?

The Cromemco Z2H has an 11Mb (unformatted) Winchester disc as well as two 5¼ floppies, a Z80 and 64K of RAM. This is the kind of small business machine that will benefit from the slowly dropping cost of the media.

The need for rapid head movement from track to track has brought about such devices as the voice coil drive. The heads are mounted on a carriage and the carriage is driven back and forth by a linear motor based on the same principle as the common loudspeaker. There is a coil mounted in a large magnet and changing the current coil causes rapid movement of the coil within the magnetic field.

Another, more modern, method of driving the heads is the taut band wrapped around the spindle of a motor such that the heads move in a straight line distance proportional to the rotation of the spindle.

The Winchester drive is packaged to give the same physical dimensions as the floppy drives it is intended to replace. The traditional belt and pulley method of driving the spindle would take up considerably more space than is available. The solution has come from the hi-fi industry in the form of a direct DC drive using servo control. The motor will be brushless and, very probably, its control will be from a quartz crystal. Other methods have also been implemented with considerable success.

Reliable Transfers

While the technology is inherently reliable it is still important to incorporate error checking and correcting techniques. It is now possible for Winchester drives to transfer data at 8,000,000 bits per second (BPS) although it is unlikely that current personal microcomputers will be able to fully utilise this speed.

Using multiple heads and discs within the same package, storage volumes of 70 million bytes are becoming common. Adding to this the fact that multiple drives can be used, it means that hundreds of millions of bytes of data can be on line. All of this is vulnerable to the whims of poor programming or even malicious damage. Despite all the promises of reliability in the Winchester drive, and as long as the disc cannot be removed from the drive for safe keeping, there will be a need for security copying. The floppy with its 100k (or so) bytes of storage and comparatively low transfer speeds is obviously not in contention as a backup device.

Rapid advances in cartridge tape technology mean that the cheap 17 million byte capacity cartridge will soon fill the need for backup. Transfer rate to these drives can be extremely high, up to about 8,000,000 bit per minute.

Memorex's 'Winnie', again with twin platters, gives about 11.7Mb of unformatted storage.

Sloppy Programming

I spoke recently to a computer professional in industry on the subject of higher capacity storage systems. Admittedly his applications are not commercial and therefore don't involve large data-file storage. His experience was that the more the dics space available the more sloppy programming became. Some discs carry multiple copies of the same program with slight variations to cope with a variety of problems. These are taking the place of one piece of well written software, to the detriment of all.

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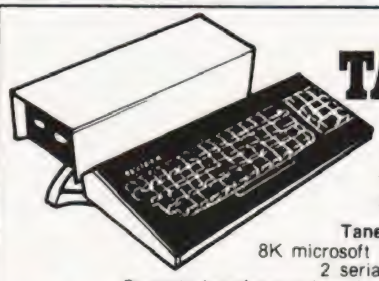

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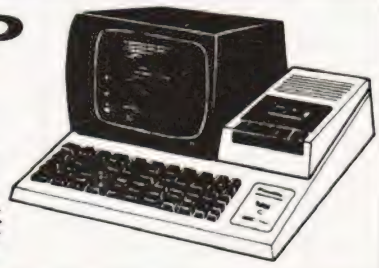

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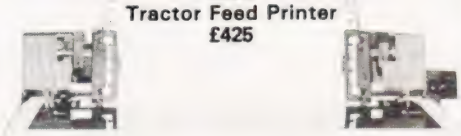

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WH14

S.C. Adams

How to win back some memory space on the ZX80.

The coming of the ZX80 has brought the cost of 'BASIC' computing down to around £100. But it also has certain limitations. One of these is that there is no place in the memory map to put extra RAM which cannot be over written. The memory map of the ZX80 is shown in Fig.1. As can be seen, the memory decoding is limited to specifying areas in sixteen kilobyte blocks in which only one "application" is allowed.

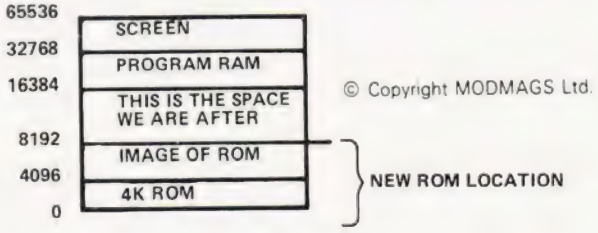


Fig 1. The memory map for a standard ZX80.

Blocks To Build With

The first sixteen kilobyte block is for the 4K Read Only Memory (ROM) which controls the operation of the ZX80. This ROM appears four times in the memory map below 16K due to the fact that the address location is not clearly defined.

The second 16K, up to 32767, is allocated to the program RAM, 1K of which is supplied, but this can be increased to 16K externally. This RAM is used from the bottom upwards, the first forty locations being used as pointers to the boundaries of the rest of the RAM. This RAM is swallowed up as the length of program increases (storing the program, variables and print statements). As the program grows these pointers are incremented, so no fixed RAM locations are possible because these might be over written by the increasing program. The stack used by the CPU also descends from the top RAM location so that it might be safe from the program, but not the stack.

The last 32K of space is used to operate the screen display of the ZX80 so it cannot be re-coded to give us more RAM space.

The only space which does not move, then, is the ROM space in the bottom 16K of the memory map, which has to be fixed in order to know where the controlling routines are. This is the space we intend using. After all, who needs four copies of one program!

The Theory

The decoding of the address is simple, IC12 pin 11 turns off the ROM by changing CS1 to a high (+5 V) whenever A14 is selected (16-32K and 49K-64K). If we add to the circuit so that the ROM is not selected when the upper half of the sixteen kilobyte block is (A13), then we will free 8K for our own use.

This is done by substituting a NOR gate for the IC13 inverter gate, so that whenever A14 OR A13 is selected IC12 turns off the ROM.

Putting Theory Into Practice

The cost of this expansion is one 74LS02 and a little soldering work, total cost 18p including VAT! The physical connections are shown in Fig.2, with the circuit diagram in Fig.3. The 73LS02 sits on top of IC12 which is located next to the keyboard on the right hand side. All the pins for the extra IC are bent outwards except for pins 14, 13 and 7 which are soldered direct to IC12. Before soldering the extra IC on top of IC12, solder a wire onto pin 9 of IC12. This will be connected to pin 11 of the extra IC, when it is mounted on top of IC12.

Solder a wire onto D8 making sure it is connected as shown, then solder the other end onto pin 12 of the new IC. Now, break the track which runs to pin 13 of IC12. This runs under the '1' of the label for IC12 and can be cut with a sharp knife. Finally make sure the pins of the new IC make no contact with the ZX80 circuit except where shown (If you do not want to use the extra pins, cut them off).

To test the modification, power up the ZX80 and the reverse K cursor should appear. Type in the following line and press "new line".

PRINT PEEK (8192)

The number 64 should appear, anything else means you must check your connections again.

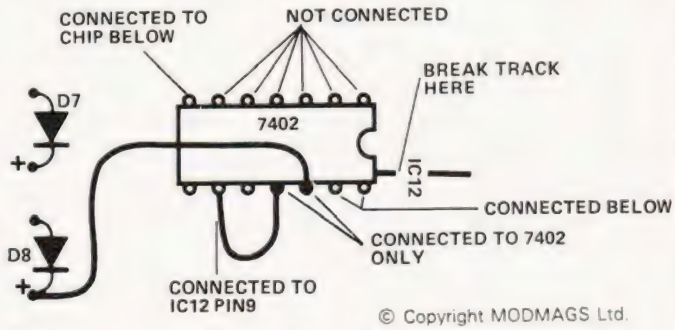


Fig 2. How to connect the extra IC.

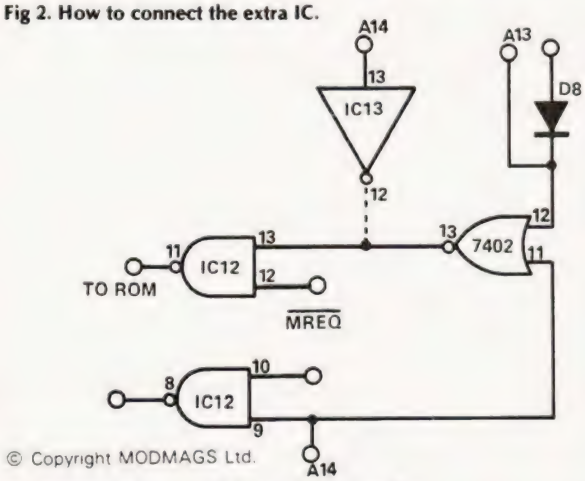


Fig 3. Circuit diagram of the address decoder.

Using It

Now we have all the memory space from 8192 to 16347 (8K) free to use for anything your heart desires; memory mapped screen for those interactive games, machine code safely tucked away without the worry of it being over written?

The ZX80 does not know this part of the RAM exists so before taping the final results of your 'Star Trek' program, transfer any machine code into the program RAM space or you will lose it when the program is SAVEd.

The new ROM from Sinclair with all those tasty extras will not be affected by this change as it will sit in the bottom 8K of the program ROM space. So, get cracking and produce the cassette file handling, printer and monitor routines that will make us the envy of the larger, heavier and more costlier machines.

CHESS RECORDER

John Wike

This program allows a NASCOM 1 fitted with T2 or T4 monitor and a Graphics Unit (Dec. 1979, p.71) to function as a chess move recorder similar to Tolinka (ETI Oct. 1978).

Games up to 59 moves in length may be entered, stored, dumped onto, or loaded from tape, the last two using the appropriate NASBUG routines. The difficulty of using the T2 'load' routine was described by M.J. Bell in his Accounting program (April 1979, p.14). His 'fool the monitor' instructions are repeated here in locations D2F-D32.

Because no shades of grey are possible on the NASCOM there are difficulties in showing a black piece on a black square (or white on white). Each piece therefore takes its own background around with it and the squares are made extra large so that they can still be seen. The board thus occupies almost the whole height of the screen.

Operation

When executed from 0C50 the graphics character generator is loaded and the chess board with alphanumeric co-ordinates is displayed on the screen. The three available commands (P,L,S) are indicated in the left hand margin.

P. Pressing P allows you to play a new game into store (EFO -FFF). The move number is now displayed in the margin and is changed after every move with two exceptions:

1. If a king is moved more than one square sideways a castling is assumed so the move number is held to allow the operator to move the rook.
2. If a pawn changes column to an unoccupied square the 'en passant' move is assumed and the move number is again held to allow the operator to remove the taken pawn by moving an empty square to its position.

Moves are entered by typing the co-ordinates of the squares in this format: letter, number, letter, number, origin first, destination second. The characters typed are displayed under the move number. The move is then indicated on the screen using 'f' (for from) and 't' (for to) at the sides of the chosen squares. If the move is acceptable, type 'Y' to execute it. If not, type 'N' to cancel it. One special feature is that if a pawn is moved to a back row it will be converted to a queen.

The game will automatically end after move 59 Black, but it can be finished at any time before that by pressing shifted backspace.

L. Pressing L clears the screen and loads the game into the game store from tape then returns to the start.

S. Pressing S causes the game in store to be displayed on the screen. Each move is indicated by 'f' and 't' as before and typing 'Y' executes a move and indicates the next one. However, this time 'N' means leave the game and return to the start.

At the end of a game a marker is inserted in the store and the lable 'END!' together with the two available commands (D,R) is displayed in the margin.

D. Pressing D dumps the stored game onto tape before returning to the start.

R. Pressing R causes an immediate return to the start.

Rules Of The Game

At no time does the program check (pun intended!) that a move complies with the rules of chess. That is left completely to the operator, so cheating is possible!

```
0C50  31 33 0C     LD SP,0C33      START  Set Stack pointer
0C53  11 00 10     LD DE,1000             Load graphics RAM
0C56  21 A3 0E     LD HL,0EA3
0C59  01 FF 6C     LD BC,6CFF
0C5C  7E           LD A,(HL)
0C5D  A9           X0R C
0C5E  12           LD (DE),A
0C5F  1F 1F 1F 1F  RRA
0C63  13           INC DE
0C64  12           LD (DE),A
0C65  13           INC DE
0C66  23           INC HL
0C67  78           LD A,B
0C68  FE 3D        CP 3D
0C6A  20 03        JRNZ C6F
0C6C  0C           INC C
0C6D  2E A3        LD L,A3
0C6F  10 EB        DJNZ C5C
0C71  EF 1E 00     PRS Clear Screen
0C74  16 08        LD D,08                Display top two rows of
0C76  0E 04        LD C,04                board
0C78  5E           LD E,(HL)
0C79  23           INC HL
0C7A  06 04        LD B,04
0C7C  7E           LD A,(HL)
0C7D  B7           0R A
0C7E  28 14        JRZ C94
0C80  12           LD (DE),A
0C81  13           INC DE
0C82  10 F8        DJNZ C7C
0C84  23           INC HL
0C85  06 04        LD B,04
0C87  7E           LD A,(HL)
0C88  12           LD (DE),A
0C89  13           INC DE
0C8A  10 FB        DJNZ C87
0C8C  2B           DEC HL
0C8D  0D           DEC C
0C8E  20 EA        JRNZ C7A
0C90  23 23        INC HL
0C92  18 E2        JR C76
0C94  D5           PUSH DE                Copy down screen
0C95  E1           POP HL
0C96  14           INC D
0C97  01 A0 02     LD BC, 02A0
0C9A  ED B0        LDIR
0C9C  21 99 0B     LD HL,0B99             Display white back row
0C9F  1E B5        LD E,B5
0CA1  06 04        LD B,04
0CA3  3E 88        LD A,88
0CA5  77           LD (HL),A
0CA6  12           LD (DE),A
0CA7  3C           INC A
0CA8  13           INC DE
0CA9  23           INC HL
0CAA  77           LD (HL),A
0CAB  12           LD (DE),A
0CAC  23 23 23     INC HL
0CAF  1B 1B 1B 1B 1B  DEC DE  1B  1B  1B  1B
0CB4  D6 03        SUB 03
0CB6  10 ED        DJNZ CA5
0CB8  21 80 81     LD HL,8180
0CBB  22 A5 0B     LD 0BA5,HL
0CBE  21 19 0B     LD HL,0B19             Display white pawns
0CC1  06 08        LD B,08
0CC3  36 8A        LD (HL),8A
0CC5  23           INC HL
0CC6  36 8B        LD (HL),8B
0CC8  23 23 23     INC HL
0CCB  10 F6        DJNZ CC3
0CCD  2E 19        LD L,19                Copy black rows
0CCF  11 99 08     LD DE,0899             from white
0CD2  0E 02        LD C,02
0CD4  06 20        LD B,20
0CD6  7E           LD A,(HL)
0CD7  E6 F0        AND F0
0CD9  FE 80        CP 80
0CDB  20 04        JRNZ CE1
0CDD  7E           LD A,(HL)
0CDE  C6 0C        ADD 0C
0CE0  12           LD (DE),A
0CE1  13           INC DE
0CE2  23           INC HL
```

```
0CE3  10 F1          DJNZ CD 6
0CE5  1E 19          LD E,19
0CE7  2E 99          LD L,99
0CE9  0D             DEC C
0CEA  20 E8          JRNZ CD4
0CEC  2E DA          LD L,DA          Display top co-ordinates
0CEE  0E 04          LD C,04
0CF0  3E 41          LD A,41
0CF2  77             LD (HL),A
0CF3  09             ADD HL,BC
0CF4  3C             INC A
0CF5  FE 49          CP 49
0CF7  20 F9          JRNZ CF2
0CF9  0E 80          LD C,80          Display side co-ordinates
0CFB  21 16 08       LD HL,0816
0CFE  3E 38          LD A,38
0D00  77             LD (HL),A
0D01  09             ADD HL,BC
0D02  3D             DEC A
0D03  FE 30          CP 30
0D05  20 F9          JRNZ D00
0D07  00             NOP
0D08  CD 95 0E       CALL MARCLR      Display commands
0D0B  EF 50 4C53 00  PRS P L S
0D10  21 F0 0E       LD HL,0EF0       Set store pointers
0D13  22 0C 0C       LD ARG 1,HL
0D16  22 10 0C       LD ARG 3,HL
0D19  CD4D 0C        CALL KBD         Await command and ex-
0D1C  FE 50          CP 50            ecute
0D1E  28 3F          JRZ D5F
0D20  FE 53          CP 53
0D22  28 12          JRZ D36
0D24  FE 4C          CP 4C
0D26  20 F1          JRNZ D19
0D28  EF 1E 1D 00    PRS ClrScrnBkSp] LOAD FROM TAPE
0D2C  CD 7C 03       CALL LOAD
0D2F  35             DEC (HL)
0D30  CD 3E 00       CALL CHIN
0D33  C3 50 0C       JP START
0D36  CD 95 0E       CALL MARCLR      ]DISPLAY STORED GAME
0D39  CD 86 0E       CALL TEXT
0D3C  2A 10 0C       LD HL,(ARG 3)    Get next move
0D3F  5E             LD E,(HL)        -origin
0D40  1C             INC E
0D41  CA 3C 0E       JP Z END         To END if FF
0D44  1D             DEC E
0D45  23             INC HL
0D46  56             LD D,(HL)        -destination
0D47  23             INC HL
0D48  22 10 0C       LD ARG 3,HL      Update pointer
0D4B  EB             EX HL,DE         Display move on screen
0D4C  CD 63 0E       CALL MIND
0D4F  CD 4D 0C       CALL KBD
0D52  FE 4E          CP 4E            If N pressed return to
0D54  28 DD          JRZ D33          START
0D56  FE 59          CP 59
0D58  20 F5          JRNZ D4F
0D5A  CD B3 0D       CALL MUPD        If Y pressed update screen
0D5D  18 DD          JR D3C
0D5F  CD 95 0E       CALL MARCLR      ]PLAY NEW GAME
0D62  CD 86 0E       CALL TEXT
0D65  01 40 04       LD BC,0440       Allow key entry in correct
0D68  21 8B 09       LD HL,098B       format
0D6B  CD 4D 0C       CALL KBD
0D6E  FE 1E          CP 1E            If shifted bk.sp. pressed
0D70  CA 3C 0E       JP Z END         go to END
0D73  5F             LD E,A
0D74  3D             DEC A
0D75  E6 F8          AND F8
0D77  B9             CP C
0D78  20 F1          JRNZ D6B
0D7A  79             LD A,C
0D7B  EE 70          X0R 70
0D7D  4F             LD C,A
0D7E  73             LD (HL),E
0D7F  23             INC HL
0D80  10 E9          DJNZ D6B
0D82  0E 02          LD C,02          Convert move from ASCII
0D84  11 8B 09       LD DE,098B       to two bytes for store
0D87  2A 10 0C       LD HL,(ARG 3)
0D8A  E5             PUSH HL
0D8B  06 02          LD B,02
0D8D  1A             LD A,(DE)
0D8E  3D             DEC A
0D8F  ED 6F          RLD
0D91  13             INC DE
0D92  10 F9          DJNZ D8D
0D94  23             INC HL
0D95  0D             DEC C
0D96  20 F3          JRNZ D8B
0D98  22 10 0C       LD ARG 3,HL      Update store pointer
0D9B  E1             POP HL
0D9C  5E             LD E,(HL)
0D9D  23             INC HL
0D9E  56             LD D,(HL)
0D9F  EB             EX HL,DE
0DA0  CD 63 0E       CALL MIND        Display move on screen
0DA3  CD 4D 0C       CALL KBD         Await command
0DA6  FE 4E          CP 4E            If N pressed cancel move
0DA8  28 0A          JRZ DB4
0DAA  FE 59          CP 59
0DAC  20 F5          JRNZ DA3         If Y pressed update screen
0DAE  CD B3 0D       CALL MUPD
0DB1  18 32          JR D65
0DB3  AF             X0R A        MUPD Clear A to show update re-
0DB4  08             EX AF             quired
0DB5  71             LD (HL),C        Remove 'f' and 't' from
0DB6  78             LD A,B           screen
0DB7  12             LD (DE),A        (HL,DE,BC are from MIND)
0DB8  D9             EXX
0DB9  21 8B 09       LD HL,098B       Clear move entry line
0DBC  06 04          LD B,04
0DBE  36 20          LD (HL),20
0DC0  23             INC HL
0DC1  10 FB          DJNZ DBE
0DC3  08             EX AF
0DC4  B7             OR A             Check whether update or
0DC5  28 0A          JRZ DD1          cancel required
0DC7  2A 10 0C       LD HL,(ARG 3)    Cancel required so
0DCA  2B 2B          DEC HL           decrement move pointer
0DCC  22 10 0C       LD ARG 3,HL
0DCF  18 E0          JR DB1
0DD1  D9             EXX              Update required so move
0DD2  13             INC DE           piece at origin to
0DD3  23             INC HL           destination
0DD4  7E             LD A,(HL)
0DD5  71             LD (HL),C
0DD6  12             LD (DE),A
0DD7  13             INC DE
0DD8  23             INC HL
0DD9  1A             LD A,(DE)        Store contents of
0DDA  47             LD B,A           destination in B
0DDB  7E             LD A,(HL)
0DDC  71             LD (HL),C
0DDD  12             LD (DE),A
0DDE  FE 97          CP 97            Was piece moved a pawn?
0DE0  28 04          JRZ DE6
0DE2  FE 8B          CP 8B
0DE4  20 26          JRNZ E0C
0DE6  4D             LD C,L           Yes. Store origin in C
0DE7  2A 10 0C       LD HL,(ARG 3)
0DEA  2B             DEC HL
0DEB  7E             LD A,(HL)
0DEC  E6 0F          AND 0F           Did it move to row 1 or 8?
0DEE  28 04          JRZ DF4
0DF0  FE 07          CP 07
0DF2  20 0B          JRZ DFF
0DF4  06 02          LD B,02          Yes. Convert to queen
0DF6  1A             LD A(DE)
0DF7  D6 0A          SUB 0A
0DF9  12             LD (DE),A
0DFA  1B             DEC DE
0DFB  10 F9          DJNZ DF6
0DFD  18 24          JR E23
0DFF  79             LD A,C           Did it change columns?
0E00  93             SUB E
0E01  E6 3C          AND 3C
0E03  28 1E          JRZ E23
0E05  78             LD A,B           Yes. Was square empty?
0E06  FE 20          CP 20
0E08  C8             RET Z            Yes. En passant
0E09  FE 9A          CP 9A
0E0B  C8             RET Z            Yes. En passant
0E0C  FE 8F          CP 8F            Was piece moved a king?
0E0E  28 04          JRZ E14
0E10  FE 83          CP 83
```

```
0E12  20 0F           JRNZ E23
0E14  B7              OR A              Yes. Did it move more
0E15  ED 52           SBC HL,DE         than 1 column?
0E17  7D              LD A,L
0E18  E6 3F           AND 3F
0E1A  28 07           JRZ E23
0E1C  FE 04           CP 04
0E1E  28 03           JRZ E23
0E20  FE 3C           CP 3C
0E22  C0              RET NZ            Yes. Castling
0E23  21 51 09        LD HL,0951        Change move display
0E26  7E              LD A,(HL)
0E27  EE 15           X0R 15            Change W to B, B to W
0E29  77              LD (HL),A
0E2A  FE 57           CP 57             Is it now W?
0E2C  C0              RET NZ
0E2D  2B              DEC HL            Yes. Increment move
0E2E  34              INC (HL)
0E2F  7E              LD A,(HL)
0E20  FE 3A           CP 3A
0E32  C0              RET NZ
0E33  36 30           LD (HL),30
0E35  2B              DEC HL
0E36  34              INC (HL)
0E37  7E              LD A,(HL)
0E38  FE 36           CP 36             Is it now move 60?
0E3A  C0              RET NZ
0E3B  E1              POP HL            Yes. Adjust SP and stay
0E3C  CD 95 0E        CALL MARCLR  END
0E3F  EF 45 4E 44 21  PRS E N D !       Display commands.
0E44  20 20 44 52 00  sp sp D R
0E49  2A 10 0C        LD HL,(ARG 3)
0E4C  36 FF           LD (HL),FF        Put end mark in store
0E4E  23              INC HL            Prepare ARG 2 for possible
0E4F  22 0E 0C        LD ARG 2,HL       DUMP
0E52  CD 4D 0C        CALL KBD          Await command and
0E55  FE 52           CP 52             execute
0E57  28 07           JRZ E60
0E59  FE 44           CP 44
0E5B  20 F5           JRNZ E52
0E5D  CD D1 03        CALL DUMP
0E60  C3 50 0C        JP START
0E63  06 02           LD B,02      MIND Convert two bytes in HL
0E65  7D              LD A,L            to two VDU pointers,
0E66  1F              RRA               origin in HL, destination in
0E67  E6 38           AND 38            DE
0E69  C6 30           ADD 30
0E6B  5F              LD E,A
0E6C  3E 07           LD A,07
0E6E  95              SUB L
0E6F  E6 07           AND 07
0E71  1F              RRA
0E72  CB 1B           RRE
0E74  C6 08           ADD 08
0E76  57              LD D,A
0E77  6C              LD L,H
0E78  D5              PUSH DE
0E79  10 EA           DJNZ E65
0E7B  E1              POP HL
0E7C  E1              POP HL
0E7D  4E              LD C,(HL)         Store backgrounds
0E7E  1A              LD A,(DE)         origin in C
0E7F  47              LD B,A            destination in B
0E80  36 66           LD (HL),66        Display pointers:
0E82  3E 74           LD A,74           'f' at origin
0E84  12              LD (DE),A         't' at destination
0E85  C9              RET
0E86  EF 4D 6F 76 65  PRS M o v e  TEXT
0E8B  20 30 31 57 20  sp 0 1 W sp
0E90  59 2F 4E 00     Y / N
0E94  C9              RET
0E95  21 56 09        LD HL,0956   MARCLR Clear the text margin and
0E98  06 0C           LD B,0C           set the cursor
0E9A  36 20           LD (HL),20
0E9C  2B              DEC HL
0E9D  10 FB           DJNZ E9A
0E9F  22 18 0C        LD CURSOR,HL
0EA2  C9              RET
0EA3  DB E8 EE 8C     Graphics 80/8C  Queen  W/B LHS
0EA7  BD 71 77 13        "     81/8D    "    W/B RHS
0EAB  EC 88 EE 8C        "     82/8E   King  W/B LHS
0EAF  73 11 77 13        "     83/8F    "    W/B RHS
0EB3  EF CC EE 8C        "     84/90  Bishop W/B LHS
0EB7  7F 3B 77 13        "     85/91    "    W/B RHS
0EBB  EF 8D FD 8C        "     86/92  Knight W/B LHS
0EBF  3F 37 33 13        "     87/93    "    W/B RHS
0EC3  AF 8A CC 8C        "     88/94  Rook   W/B LHS
0EC7  5F 15 33 13        "     89/95    "    W/B RHS
0ECB  FF CE CE FC        "     8A/96  Pawn   W/B LHS
0ECF  FF 37 37 F3        "     8B/97    "    W/B RHS
0ED3  00 00 FF FF        "       98    Board
0ED7  FF FF 00 00        "       99     "
0EDB  FF FF FF FF        "       9A     "
0EDF  18  9A 20       Board set up table (used at C74)
0EE2  58  99  98
0EE5  98  20  9A
0EE8  D8  98  99
0EEB  18 00
EF0 upwards           Game store.
```

CASSETTE MODS

J.C. Corrall

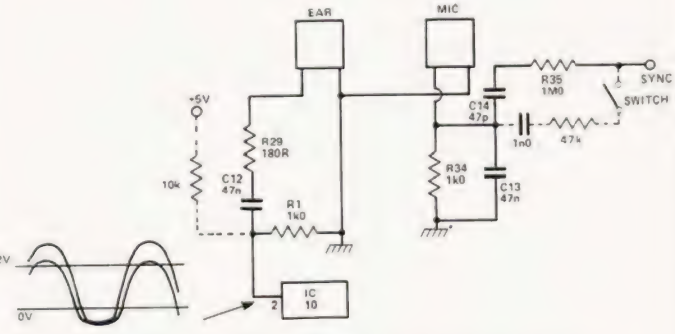
The cassette interface on the Sinclair ZX80 has been reported to be reasonably effective. However, the simple modifications shown in the diagram help to make it both more reliable and versatile.

Saving The Day

The signal output from the computer to the cassette recorder is usually about 1 or 2 mV RMS. while SAVEing, which is about the right level for the microphone input of many cassette recorders. Unfortunately the small size of this signal means there is always a danger from ambient noise. With the additions to the circuit shown, closing the switch raises the output signal to about 30 mV, which makes it compatible with the "Auxiliary" socket on cassette recorders. A ZX80 modified in this way has also been found to give satisfactory recordings when connected to the DIN socket of a music centre. Playback is made through the headphone socket to the computer.

When loading a program, the signal from the cassette recorder is fed to an LS TTL buffer, which requires at least 2 V on its input to register a logic 1. A cassette recorder that runs from 6 V, for example, can be hard pushed to supply this sort of signal without severe distortion.

However, a 10 k resistor added as shown, forms a potential divider with R1, and adds an 0.5 V DC shift to the signal. This has been found to allow reliable program loading over a range of cassette volume control settings.



The simple cassette interface changes, the extra connections are shown dotted. Component designations relate to S of C's circuits.

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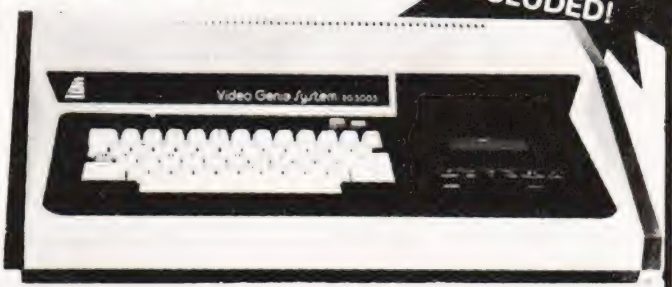

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Trevor Lusty

The solution to the problem of Queens reveals some elegant data handling

The trouble with classic problems is that people expect classic solutions. I once had the misfortune of attending an hour-long lecture on the Eight Queens Problem where the lecturer seemed more interested in proving how clever he was than finding a solution. So, I shall do my best not to fall into the same trap.

Data Structures

As with most problems which refer to physical objects, the first thing to do is to decide how to represent them within the computer. The data structure chosen should convey sufficient information to solve the problem but omit superfluous items irrelevant to the solution. If we consider the situation in Fig. 1 we can see that a two dimensional array is unnecessary, as all the required information may be held in the eight simple variables, A to H.

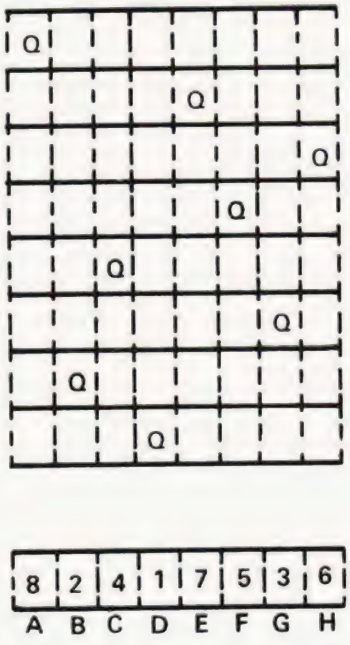

Fig.1 The use of a set of simple variables will allow a significant increase in speed.

The biggest advantage of using simple variables is one of speed. The computer can find the value of a simple variable at least twice as fast as that of an array variable. Whilst talking of speed it is also worth noting that FOR . . . NEXT loops are normally much quicker than other looping structures. A complete list of benchmark programs appeared in the October issue, but running and timing the following two short programs should help clarify the points just made:-

```
10 FOR I = 1 TO 5000
20 LET A = 1
30 NEXT I
40 END
```

```
10 LET J = 5 : LET I = 1
20 LET A (J) = I
30 LET I = I + 1 : IF I < = 5000 THEN 20
40 END
```

Both these programs store 5000 numbers, but the first uses a FOR . . . NEXT loop and simple variable, the second uses a single element of an array variable and an IF . . . THEN loop. I think you might be very surprised by the difference in the times taken to execute them.

Threat Testing

The requirements for solving the problem are,

1) No two Queens in the same column.
2) No two Queens in the same row.
3) No two Queens on the same diagonal.

The first of these requirements is met by having eight simple variables, as each of these can only hold a single number giving the position of the Queen in one of the columns. Providing that all these numbers are different, no two Queens may be in the same row, and the second condition is satisfied. There is a simple test for the third condition which is illustrated by Fig. 2.

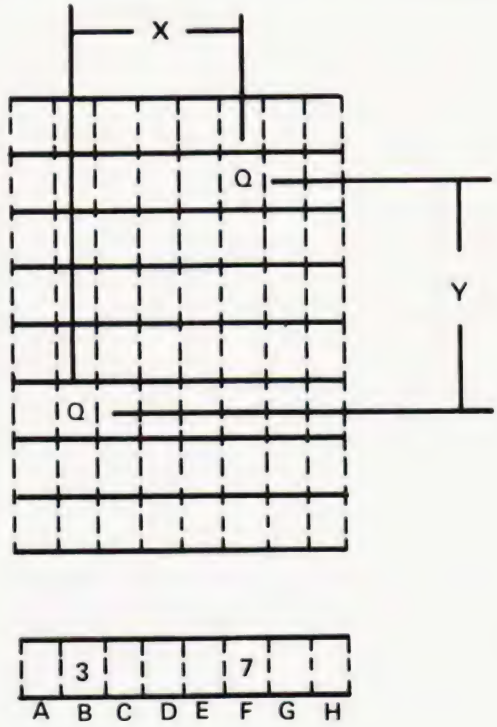

Fig.2 The test for a diagonal 'threat' is neatly illustrated.

The two Queens will be on the same diagonal when X = Y. If X is not equal to the distance Y then they are on different diagonals. In the case shown, we must test for B − F = 4, but as the second Queen may be above or below the first this must be coded as ABS (B − F) = 4.

For the sake of speed, tests must be made as soon as possible in the program. There is no point in fitting the third Queen if the second Queen is threatened by the first,. The following program finds all 92 solutions to the problem.

Duplicates

Many of the 92 solutions are not really unique. A square template may be placed in a square box in eight different ways, so each solution may be reflected and rotated to give seven more solutions. You might like to amend the program so that it only prints the 12 unique solutions, and then explain why 92 is not divisible by eight!

```
100 REM **PROGRAM ---- EIGHT QUEENS
101 REM **PROGRAMMED IN 'PET' BASIC
190 FOR A=1 TO 8
200 FOR B=1 TO 8
210 IF A=B OR ABS(A-B)=1 THEN 620
220 FOR C=1 TO 8
230 IF A=C OR ABS(A-C)=2 THEN 610
240 IF B=C OR ABS(B-C)=1 THEN 610
250 FOR D=1 TO 8
260 IF A=D OR ABS(A-D)=3 THEN 610
270 IF B=D OR ABS(B-D)=2 THEN 610
280 IF C=D OR ABS(C-D)=1 THEN 610
290 FOR E=1 TO 8
300 IF A=E OR ABS(A-E)=4 THEN 590
310 IF B=E OR ABS(B-E)=3 THEN 590
320 IF C=E OR ABS(C-E)=2 THEN 590
330 IF D=E OR ABS(D-E)=1 THEN 590
340 FOR F=1 TO 8
350 IF A=F OR ABS(A-F)=5 THEN 580
360 IF B=F OR ABS(B-F)=4 THEN 580
370 IF C=F OR ABS(C-F)=3 THEN 580
380 IF D=F OR ABS(D-F)=2 THEN 580
390 IF E=F OR ABS(E-F)=1 THEN 580
400 FOR G=1 TO 8
410 IF A=G OR ABS(A-G)=6 THEN 570
420 IF B=G OR ABS(B-G)=5 THEN 570
430 IF C=G OR ABS(C-G)=4 THEN 570
440 IF D=G OR ABS(D-G)=3 THEN 570
450 IF E=G OR ABS(E-G)=2 THEN 570
460 IF F=G OR ABS(F-G)=1 THEN 570
470 FOR H=1 TO 8
480 IF A=H OR ABS(A-H)=7 THEN 560
490 IF B=H OR ABS(B-H)=6 THEN 560
500 IF C=H OR ABS(C-H)=5 THEN 560
510 IF D=H OR ABS(D-H)=4 THEN 560
520 IF E=H OR ABS(E-H)=3 THEN 560
530 IF F=H OR ABS(F-H)=2 THEN 560
540 IF G=H OR ABS(G-H)=1 THEN 560
550 PRINT A;B;C;D;E;F;G;H
560 NEXT H
570 NEXT G
580 NEXT F
590 NEXT E
600 NEXT D
610 NEXT C
620 NEXT B
630 NEXT A
```

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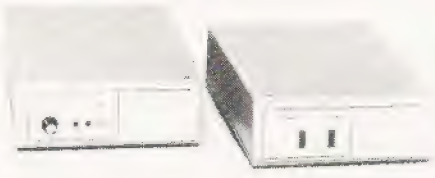

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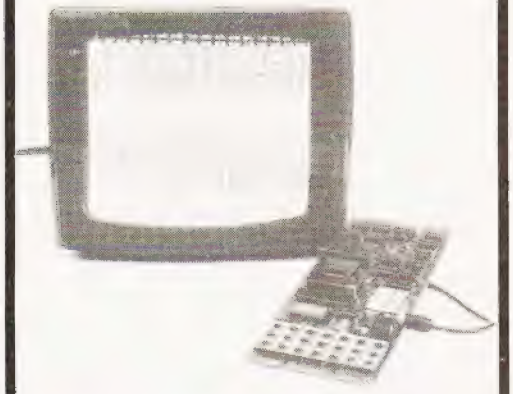

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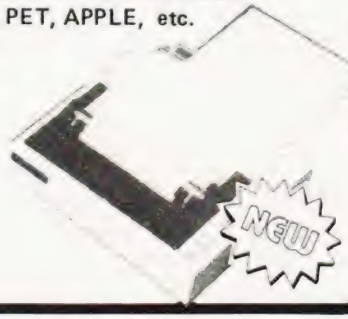

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Trevor Lusty

Concluding our series on the use of graphics, we present Breakthrough.

As we progress deeper into the graphics jungle so we move further away from any pretence at common standards. To write a general article on PEEK and POKE is relatively easy because most modern micro's have a memory mapped display and their BASIC's support these statements. Cursor control is more difficult because not all machines have it, and those that do have different methods of implementing it. In this article we are going to look at the actual characters which a micro may display and this depends not only on the hardware and software, but also on the manufacturer's philosophy towards graphics.

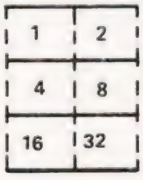
Shades Of Definition

Let's start by considering each character position on the screen as a rectangle which may be either on (white) or off (black). On the RM 380Z this would give us a basic resolution of 40 across by 24 down, on the TRS 80 it would be 64 by 16 and on the PET it would be 40 by 25. If we only had this definition to work with, all pictures would be very crude and difficult to decipher. However, each character position is itself made up of a matrix of dots. The size of this matrix varies from machine to machine but let's take the RM 380Z standard of six dots wide by nine dots high as an example. If we could switch each of these dots on and off individually our resolution would leap from 40 by 24 to 240 by 216 and we would have what is known as high resolution graphics. The snag is that you would require more memory and additional hardware with a resultant increase in the price of the machine.

Manufacturers have solved this problem in a variety of ways, but most use the fact that normal characters (ABC . . . , abc . . . , /* + − . . . etc.) need only half of the 256 combinations available in a single 8-bit byte. They use the remaining codes to define new characters which may be specially designed à la PET & Sharp MZ-80K, or chunky like the TRS 80 and RM 380Z.

Pixel Characters

The chunky graphics referred to above are known as Pixel Characters and this type of graphics is similar to that used in 'Teletext' transmissions on BBC and ITV. Each character is about three times as high as it is wide and includes six blocks, each of which may be thought of as having a specific value. Each character has an ASCII code and these are allocated as if the six positions had values 1, 2, 4, 8, 16 and 32 as shown in the following diagram.:-



How the pixel character can be encoded.

Using this method we can consider the TRS 80 screen as an 128 by 48 grid, and the RM 380Z screen as an 80 by 72 grid, both machines have statements which allow you to switch individual pixels 'on' or 'off'. However, these statements differ from machine to machine, and each of the manufacturers has numbered the screen in a different way. The TRS 80 uses SET and RESET with the grid numbered across and down, RM 380Z uses PLOT with the grid numbered across and up. By way of an explanation here are two programs, one for each machine, which produce an ever changing pattern over the complete screen.

```
10  REM ** TRS 80
15  CLS
20  X = RND (128) - 1
25  Y = RND (48) - 1
30  SET (X, Y)
35  X = RND (128) - 1
40  Y = RND (48) - 1
45  RESET (X, Y)
50  GOTO 20
```

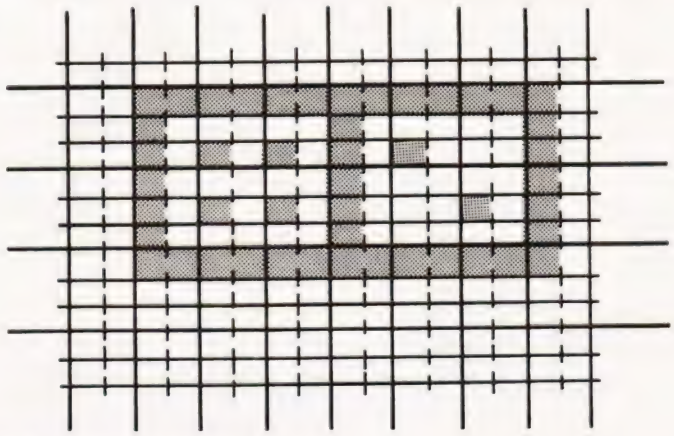
The X and Y co-ordinates are selected randomly using the TRS 80s random number generator, which is able to select integers within a given range. SET (X, Y) switches the required pixel 'on' and RESET (X, Y) switches a pixel 'off'.

```
10  REM ** RM 380Z
12  GRAPH 1
15  PRINT CHR$ (12)
20  X = 80 * RND (1)
25  Y = 60 * RND (1)
30  PLOT X, Y, 2
35  X = 80 * RND (1)
40  Y = 60 * RND (1)
45  PLOT X, Y, 0
50  GOTO 20
```

The GRAPH 1 statement switches on the graphics 'window' of the RM 380Z, which does not cover the complete area of the screen. This is why 60, rather than 72, is required in lines 20 and 40. The machine also has the capability of plotting both grey and white pixels, all that is required is a change from 2 to 1 in line 30. (ie 0 for off, 1 for grey and 2 for white).

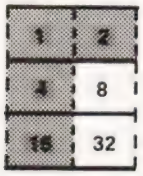
Shape Reduction

The SET or PLOT statements are fine for producing graphs, but the method becomes tedious if large shapes are required on the screen. However, it is possible to save time and energy by printing the ASCII character which corresponds to a given 3 by 2 shape. Let's imagine that we wish to print a reduced version of the following domino:-



A double domino generated from pixel characters.

You will see that the grid has has a 3 by 2 pattern marked over it, and the top left-hand portion of the domino has the following shape:-



One segment showing the pixel value.

The total of the 'on' squares is 23 and the pixel graphics have ASCII codes starting at 128. The ASCII code for our character is 128 + 23 = 151, and therefore the statement PRINT CHR$ (151) will print it on the screen at the current cursor position.

Pseudo-Chunkies

As stated earlier, not all machines have graphics of this type, but it is often possible to write a routine to accomplish the same function. Providing the machine has a complete set of quarter square graphics it is possible to PEEK the screen to see what is already there, and then POKE back the updated character. This is possible with the PET and the technique is usually referred to as double density graphics.

Being, by nature, a lazy person I searched for an easy way to incorporate double density shapes into my programs. The following program allows me to design a shape using full size blocks and then, when I press RETURN, it automatically produces a string (SH$) which represents the half size picture.

```
100 REM**SHAPE REDUCER
120 DIM SH(9,11),SY$(15)
130 CD$=" [HOME ] [15XCRD ]":
    CR$=" [25XCRR ]"
140 FOR I=0 TO 15:
    READ SY$(I):
    NEXT I
150 DATA " [SP ]"," [> ]"," [< ]"," [RVS ] [" ]
    [OFF ]"," [; ]"," [! ]"," [RVS ] [? ]
    [OFF ]"," [RVS ] [, ] [OFF ]"
160 DATA " [, ]"," [? ]"," [RVS ] [! ] [OFF ]","
    [RVS ] [; ] [OFF ]"," [" ]"," [RVS ]
    [< ] [OFF ]" " [RVS ] [> ] [OFF ]","
    [RVS ] [SP ] [OFF ]"
170 L=0:
    M=0
180 PRINT " [CLR ]";RT$;" [20X& ]"
190 FOR I=1 TO 10
200 PRINT RT$;" [4X& ] [12XSP ] [4X& ]"
210 NEXT I
220 PRINT RT$;" [20X& ]"
230 GOTO 360
240 PRINT " [SP ] [CRL ]";:
    FOR I=1 TO 50:
    GET A$:
    IF A$<>" " THEN 270
250 NEXT I:
    PRINT " [RVS ] [SP ] [OFF ] [CRL ]";:
    FOR I=1 TO 50:
    GET A$:
    IF A$<>" " THEN 270
260 NEXT I:
    GOTO 240
270 IF SH(L,M)=0 THEN PRINT " [SP ] [CRL ]";
280 IF SH(L,M)=1 THEN PRINT " [RVS ] [SP ] [OFF ]
    [CRL ]";
290 IF A$=CHR$(13) THEN 480
300 IF A$=" [SP ]" OR A$=" [RVS ]" THEN 380
310 IF A$=" [CRR ]" THEN M=M+1
320 IF A$=" [CRL ]" THEN M=M-1
330 IF A$=" [CRU ]" THEN L=L-1
340 IF A$=" [CRD ]" THEN L=L+1
350 GOSUB 430
360 PRINT LEFT$(CD$,L+2);LEFT$(CR$,M+4);
370 GOTO 240
380 IF A$=" [SP ]" THEN PRINT " [SP ]";:
    SH(L,M)=0:
    M=M+1
390 IF A$=" [RVS ]" THEN PRINT " [RVS ] [SP ]
    [OFF ]";:
    SH(L,M)=1:
    M=M+1
400 GOSUB 430:
    PRINT LEFT$(CD$,L+2);LEFT$(CR$,M+4);:
    GOTO 240
410 REM**ADJUST POSITION
430 IF M<0 THEN M=11:
    L=L-1:
    IF L<0 THEN L=9
440 IF M>11 THEN M=0:
    L=L+1:
    IF L>9 THEN L=0
450 IF L<0 THEN L=9:
    M=M-1:
    IF M<0 THEN M=11
460 IF L>9 THEN L=0:
    M=M+1:
    IF M>11 THEN M=0
470 RETURN
480 SH$=" ":
    FOR L1=0 TO 8 STEP 2:
    FOR M1=0 TO 10 STEP 2
490 VX=SH(L1,M1)+2*SH(L1,M1+1)+4*SH(L1+1,
    M1)+8*SH(L1+1,M1+1):
    SH$=SH$+SY$(VX)
500 NEXT M1:
    SH$=SH$+" [CRD ] [6XCRL ]"
510 NEXT L1:
    SH$=SH$+" [2XCRU ]"
520 PRINT " [HOME ]";TAB(25);SH$;" [11XCRD ]"
530 GOTO 360
```

The 16 quarter square patterns are stored in SY$ and READ from DATA statements in lines 150 and 160. Lines 240 to 260 are an INPUT routine which shows the position of the cursor on the screen, and the cursor position may be altered using the usual cursor control buttons. The RVS button will PRINT a white square and the SPACE bar a black square.

The conversion routine which reduces the size of the shape takes place in lines 480 to 510. Once the reduced shape has been printed, control returns to the main program so that

the original pattern may be altered. When you are satisfied with the result, the string SH$ contains the required characters and may be inserted in another program

A Final Breakthrough

Well, if you've managed to get this far with the series, you are more than likely ready for a bit of relaxation. So the final program is designed to show how all we have covered so far may be put together to form a complete working program, in this case the game of BREAKTHROUGH. For those of you who are unfamiliar with it, the game consists of bouncing a ball off a bat so that it rebounds to knock pieces out of a barrier. Your score increases with each piece removed, and if you obtain enough points within the time limit you win a replay.

When I started to experiment with the component subroutines for the program, it soon became clear that a version written entirely in BASIC would be far to slow. So I looked for a frequently used routine which could be easily translated into machine code. I wanted this section to be self-contained, as access to variables used in the BASIC part of the program would be difficult. I finally chose the bat moving routine, for it is called more often than any other and is almost independent from the rest of the coding. It also had the advantage that it could be tested without the BASIC program, thus speeding up the usual debugging. Here is 6502 assembler listing of the final version:-

```
033A                    1   ! BAT MOVE ROUTINE
033A                    2   !
033A  A5 97             3   LDA 151
033C  C9 29             4   CMP #41
033E  F0 07             5   BEQ VAL1
0340  C9 2A             6   CMP #42
0342  F0 10             7   BEQ VAL2
0344  4C 5E 03          8   JMP PLOT
0347  AD 7B 03          9   VAL1 LDA POSIT
034A  C9 23            10   CMP #35
034C  B0 10            11   BCS PLOT
034E  EE 7B 03         12   INC POSIT
0351  4C 5E 03         13   JMP PLOT
0354  AD 7B 03         14   VAL2 LDA POSIT
0357  C9 02            15   CMP #2
0359  90 03            16   BCC PLOT
035B  CE 7B 03         17   DEC POSIT
035E  20 70 03         18   PLOT JSR BLANK
0361  AE 7B 03         19   LDX POSIT
0364  A0 04            20   LDY #4
0366  A9 E2            21   LDA #226
0368  9D 98 83         22   BAT STA SCREEN,X
036B  E8                23   INX
036C  88                24   DEY
036D  D0 F9             25   BNE BAT
036F  60                26   RTS
0370                    27   ! BLANK A BLOCK
0370  A2 26             28   BLANK LDX #38
0372  A9 20             29   LDA #32
0374  9D 98 83         30   NEXT1 STA 33688,X
0377  CA                31   DEX
0378  D0 FA             32   BNE NEXT1
037A  60                33   RTS
037B                    34   POSIT = *
8398                    35   SCREEN = 33688
037B                    36   .END
```

The Hex coding was then changed into decimal and incorporated into the BASIC program as DATA statements. When the program is run, it loads the routine into the PET's second cassette buffer and calls it with the SYS (826) statement. Here is a complete listing of the final program with the machine code routine starting in line 850:-

```
100 REM**BREAKTHROUGH
150 POKE 59468,14:
    PRINT " [CLR ] [7XSP ] [RVS ]THIS GAME IS
    BREAKTHROUGH"
160 PRINT " [2XCRD ] THE OBJECT OF THE GAME
    IS TO KNOCK AS"
170 PRINT "MANY BRICKS FROM THE WALL AS
    POSSIBLE."
180 PRINT " [2XCRD ] TO DO THIS YOU MUST
    BOUNCE THE BALL OFF";
190 PRINT "THE BAT AT THE BOTTOM OF THE
    SCREEN."
200 PRINT " [2XCRD ] THERE IS A TIME LIMIT OF
    SEVEN MINUTES"
210 PRINT "FOR EACH GAME, BUT YOU EARN A
    REPLAY IF"
220 PRINT "YOU SCORE MORE THAN 750 POINTS."
230 PRINT " [2XCRD ] TO MOVE THE 'BAT' TO THE
    LEFT PRESS THE"
240 PRINT "4 KEY."
250 PRINT " [CRD ] TO MOVE THE 'BAT' TO THE
    RIGHT PRESS THE";
260 PRINT "6 KEY."
270 GOSUB 870:
    PRINT" [3XCRD ] [8XSP ] [RVS ]PRESS ANY
    KEY TO BEGIN.";
280 GET A$: IF A$=" " THEN 280
290 REM**SET UP SCREEN
300 PRINT " [CLR ]";:
    S=33050+INT(RND(1)*37):
    TI$="000000":
    J=1: PO=0
310 POKE 59468,12:
    PRINT " [HOME ] [RVS ] [40X # ] [OFF ]"
320 PRINT " [CRD ] [39X& ]"
330 PRINT " [RVS ] [39XZ ]"
340 PRINT " [RVS ] [39XV ]"
350 FOR M=32808 TO 33728 STEP 40:
    POKE M,229:
    POKE M+39,231:
    NEXT M
360 PRINT " [HOME ] [CRD ] [29XCRR ]BALL # ";J
370 PRINT " [HOME ] [2XCRD ] [15XCRR ]SCORE
    ";PO
380 M=INT(RND(1)*2):
    B=39: IF M=1 THEN B=41
390 POKE S,81:
    S=S+B: IF S>32810 THEN 440
400 REM**CHECK THE CORNERS
410 IF S=32768 THEN S=32809:
    B=41: GOTO 390
420 IF S=32807 THEN S=32846:
    B=39: GOTO 390
```

```
430 REM**TIME ROUTINE
440 IF TI$>"000700" THEN 700
450 PRINT " [HOME ] [CRD ] [CRR ]TIME
    ";MID$(TI$,4,1);":";RIGHT$(TI$,2)
460 REM**MOVE THE BAT AND BALL
470 REM**WHEN PATH IS CLEAR.
480 SYS 826:
    IF S>33768 THEN 590
490 IF PEEK(S)=32 THEN POKE S,81:
    POKE S-B,32: S=S+B:
    SYS 826: GOTO 450
500 REM**WHAT HAVE WE BUMPED INTO?
510 IF PEEK(S)=229 THEN 560
520 IF PEEK(S)=231 THEN 570
530 IF PEEK(S)=226 THEN 620
540 IF PEEK(S)<>227 THEN 650
550 S=S-B:
    POKE S,32: B=80-ABS(B):
    S=S+B: GOTO 440
560 S=S-B: POKE S,32:
    B=B+2: S=S+B:
    GOTO 440
570 S=S-B: POKE S,32:
    B=B-2: S=S+B:
    GOTO 440
580 REM**BALL LOST ROUTINE
590 POKE (S-B),32:
    FOR Z=1 TO 50:
    FOR Z1=1 TO 10:
    NEXT Z1: SYS 826:
    NEXT Z
600 J=J+1:
    S=33075+INT(RND(1)*5):
    GOTO 360
610 REM**BOUNCE BALL OFF BAT
620 S=S-B: POKE S,32:
    B=B-80: S=S+B:
    GOTO 440
630 REM**UPDATE SCORE AND
640 REM**DELETE TARGET.
650 POKE (S-B),32:
    IF PEEK(S)=102 THEN PO=PO+5:
    IF B>0 THEN B=B-80:
    GOTO 670
660 IF B<0 THEN B=80+B
670 PO=PO+5:
    IF PO>=750 THEN 700
680 POKE S,81:
    PRINT" [HOME ] [2XCRD ] [15XCRR ]SCORE
    ";PO:
    S=S+B: GOTO 440
690 REM**RESULTS ROUTINE
700 TM=60*VAL(LEFT$(TI$,4))+VAL(RIGHT$(TI$,
    2))
710 FOR M=32768 TO 33767:
    POKE M,160: NEXT M
720 POKE 59468,14:
    PRINT" [CLR ] [CRD ]BALLS USED";J
730 PRINT" [CRD ]TIME TAKEN";TM;"SECONDS"
740 PRINT " [CRD ]SCORE IS";PO
750 BF=INT(((PO+100)/J)*10)/10
760 PRINT" [CRD ]YOUR BREAKTHROUGH FACTOR
    IS";BF
770 IF PO>=750 OR BF>20 THEN 830
780 REM**REPLAY ROUTINE
790 POKE 158,0:
    INPUT" [2XCRD ] [RVS ]DO YOU WANT A
    REPLAY [OFF ] ";A$
800 IF LEFT$(A$,1)="Y" THEN 300
810 IF LEFT$(A$,1)<>"N" THEN PRINT " [CRD ]
    [RVS ]ANSWER 'Y' OR 'N' [5XCRU ]":
    GOTO 790
820 POKE 59468,12:
    PRINT" [CLR ] [3XCRD ] THANKS FOR
    PLAYING": END
830 PRINT" [HOME ] [14XCRD ] [11XCRR ] [RVS ]
    YOU WIN A REPLAY"
840 FOR RR=0 TO 3000:
    NEXT RR: GOTO 300
850 REM**MACHINE CODE ROUTINE
860 REM**TO MOVE THE BAT.
870 FOR IT=0 TO 65: READ DA:
    POKE 826+IT,DA:
    NEXT IT:
    RETURN
880 DATA 165, 151, 201, 41, 240, 7, 201, 42, 240, 16,
    76, 94
890 DATA 3, 173, 123, 3, 201, 35, 176, 16, 238, 123, 3,
    76
900 DATA 94, 3, 173, 123, 3, 201, 2, 144, 3, 206, 123, 3
910 DATA 32, 112, 3, 174, 123, 3, 160, 4, 169, 226,
    157, 152
920 DATA 131, 232, 136, 208, 249, 96, 162, 38, 169, 32,
    157, 152
930 DATA 131, 202, 208, 250, 96, 20
```

I hope that the REMark statements will enable you to follow the program, but here is a general description. The ball is moved under POKE control and variable S holds the screen address position it will move to. The move is made by POKE-ing a ball symbol (Screen Code = 81) to location S and a space (Screen Code = 32) to the current position.

The information about the current state of play is found by PEEKing the screen location S. The values obtained are tested in lines 510 to 540, and a jump is executed to the appropriate position.

The time elapsed, score and ball number are all printed onto the screen under cursor control. The instructions, the results routine and other messages also use this method of display. My version has both upper and lower case characters but I have shifted them all to upper case so that the listing is more readable. Remember that my lister replaces graphics characters with upper case letters in square brackets, eg the [39 x Z] in line 300 means 39 shifted Z's.

The program is fairly fast, with most of the time being spent in the loop from line 450 to 490. If you want to speed it up still further, change the last statement in line 490 to GOTO 480. The only adverse effect of this is that the clock will not be updated continuously.

Well, that's it, but remember that if you POKE successfully send your results to COMPUTING TODAY so that we can all have a PEEK!

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Bob Perrigo

PC1211 PROGRAMS

Applications are the prime target for the PC1211.

To illustrate the incredible versatility of the PC1211 from Sharp Electronics here are three simple programs. Whilst none could be called complex they do serve to illustrate some of the possible areas of use to which this hand-held 'computer' can be put. All the programs should run equally well on the new Tandy machine, simply a re-packaged PC1211.

If the response is sufficient we will consider publishing programs for this machine in our Softspot feature but readers are advised to read the Submissions feature in last month's issue before committing pen to paper.

Phone

Anyone with a wife or daughter will know the cost of those hour-long telephone calls! Seriously though, the cost of phone calls can mount up almost magically unless a careful check is kept.

This program enables the user to keep such a check. Switched on at the beginning of a call, it displays the cost of the call as it proceeds, bringing home harsh financial reality and encouraging brevity.

On typing RUN the computer will prompt for distance band L, A or B. It then requests the appropriate charge rate, cheap (c), standard (s) or peak (p) depending on the time of day. The call is then dialled and when the recipient answers press the ENTER key. The cost of the call is then continuously displayed. This includes the often-forgotten VAT. As the charge unit time intervals pass the computer 'beeps' to draw your attention to the increasing cost.

When the call is complete press BREAK and type RUN 100. The total cost of that call will then be displayed. Hard evidence for extracting some contribution to the bill from a garrulous daughter with a boyfriend in Aberdeen!

To make the alterations which will inevitably be required as charges continue to rise the value of 4.025p in lines 40 and 90 will need changing.

```
 10 REM"FOR CHARGE+RATE SEE DIALLING CODE
    BOOK"
 20 REM"TO STOP PRESS BREAK, RUN 100 FOR
    TOTAL"
 30 INPUT "CHARGE(L)=1(A)=2(B)=3";C
 35 INPUT " RATE(C)=1(S)=2(P)=3";R
 40 T=(C*3)+R:U=4.025
 45 IF T<4 THEN 30
 50 IF T>12 THEN 30
 55 GOSUB 100+T
 60 PRINT" DIAL CALL, PRESS ENTER"
 65 PRINT" WHEN CALL ANSWERED"
 70 FOR I=1 TO F
 75 PAUSE "THIS CALL COSTS";USING "####"
    ;U;"P"
 80 NEXT I
 85 BEEP B
 90 U=U+4.025
 95 GOTO 70
100 PRINT " THAT CALL COST ";USING"####";U;
    "P"
102 END
104 F=496:B=3:RETURN
105 F=124:B=3:RETURN
106 F=83:B=2:RETURN
107 F=124:B=3:RETURN
108 F=30:B=3:RETURN
109 F=20:B=2:RETURN
110 F=41:B=3:RETURN
111 F=10:B=1:RETURN
112 F=6:B=3:RETURN
```

Currency Conversion

On holiday, in the course of business or in studying economics it is often desirable to be able to convert quickly from one currency to another and perhaps to make comparison with a third. In its present form this program applies to the six currencies in the list. It would, however, be a simple matter to increase this number.

The values of major currencies and their exchange rates with the pound are published in many newspapers, particularly the Financial Times. Current values have to be entered before the program is run. This is done by typing RUN 100 and responding to the prompts of the program.

Once the values are entered the program may be run interactively in the normal way.

The following abbreviations are used in the program:-

#	= Pounds
$	= Dollars
D.M.	= Deutsch Marks
S.F.	= Swiss francs
YEN	= Yen
RAND	= Rand (South African)

```
  5 INPUT " ENTER CURRENCY 1 ? ";A$
 10 INPUT " ENTER AMOUNT ? ";B
 15 IF A$=" #" P=B:GOTO 50
 20 IF A$="$" P=B*1/D:GOTO 50
 25 IF A$="D.M"P=B*1/M:GOTO 50
 30 IF A$="S.F" P=B*1/F:GOTO 50
 35 IF A$="YEN"P=B*1/Y:GOTO 50
 40 IF A$="RAND" P=B*1/R:GOTO 50
 45 GOTO 5
 50 INPUT" ENTER CURRENCY 2? " ;C$
 55 IF C$=" #" E=P:GOTO 90
 60 IF C$="$" E=P*D:GOTO 90
 65 IF C$="D.M"E=P*M:GOTO 90
 70 IF C$="S.F" E=P*F:GOTO 90
 75 IF C$="YEN"E=P*Y:GOTO 90
 80 IF C$="RAND" E=P*R:GOTO 90
 85 GOTO 50
 90 E=INT (E*100+.5)/100:BEEP 3
 95 PRINT" ";A$;" ";B;" = ";C$;" ";E:END
100 INPUT" ENTER VALUE (D.M) ? ";M
105 INPUT" ENTER VALUE (YEN) ? ";Y
110 INPUT" ENTER VALUE (RAND) ? ";R
115 INPUT" ENTER VALUE (S.F) ? ";F
120 INPUT" ENTER VALUE ($) ? ";D:END
```

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TRITON DATA

John Owen

Although Triton's 'READ (Port)' command is very useful, there are times when the more conventional 'READ (DATA)' command would be handy. The program which follows performs the READ, DATA and RESTORE commands.

Rather than using BASIC 'Calls', the main command table (TAB 2) in the BASIC Interpreter is extended in RAM as TAB 7. When the Interpreter reaches the end of TAB 2 without a match it jumps to 1471H. Using the BASIC statement 10 POKE 4234, 8164 the Interpreter is re-vectored from 1471H to 1FE4H (i.e. 8164_{10}) where it finds instructions to search TAB 7.

TAB 7 contains SET, DATA and RESTORE commands together with the addresses of the routines to perform these commands. TAB 7 also contains address 0749H which is the Interpreter's default address, to which it jumps if no match is found.

The Routines

DATA: When the Interpreter encounters the first DATA command the address of the DATA Line Number in the BASIC text (which is obtained from CURRENT at 14B7 and 14B8H) is stored at 1414 and 1415H. RAM from 1410 to 1430H is used exclusively for the monitor input buffer and, as it is very unlikely to be used during a BASIC program it is used here to save wasting RAM which could be used for BASIC text. The address of the first item of data is also saved at DATA INIT and DATA PLACE.

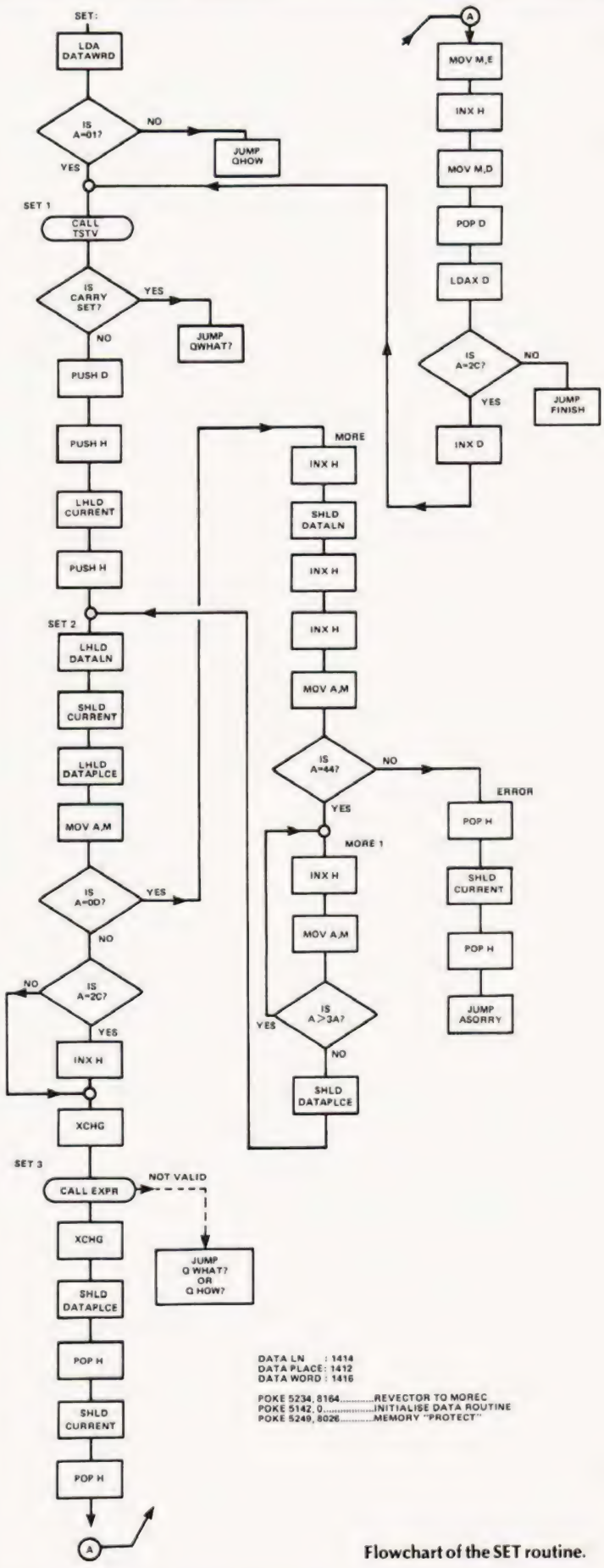
The DATA routine also changes the DATAWORD (1416H) from 00 to 01. When the second and subsequent DATA statements are encountered, the lines are then simply 'skipped' over. In order for a DATA statement to be 'READ' again, when the BASIC program is re-run, the DATAWORD must be changed back to 00. This is done by using the BASIC statement 10 POKE 5142,0.

Any amount of data may be set up in a DATA statement and the data may be numeric, expressions or variables which have already been set up, eg. 20 DATA 2,34, @ (A), -5,A+6. The program may contain any number of DATA statements but they must be on consecutive lines and they must appear before a SET command. No other command can appear in a DATA statement.

RESTORE: This routine simply obtains the address of the first item of data (from DATA INIT) and places it in DATA PLACE which holds the address of the current item of data. RESTORE, which may be abbreviated to RES., can appear anywhere in the BASIC program either on its own or in 'multi-statements' eg. 50 IF A=5 RESTORE; GOTO 30.

SET: This is the most complex routine since all the error detecting routines are carried out here. The routine starts by checking that DATAWORD is 01, indicating that a DATA statement has been encountered by the Interpreter. The routine then obtains the address of the variable which follows the SET command and saves it on the stack along with the Interpreter's current position. The current item of data is obtained, decoded and placed in the variable address which was saved on the stack. The routine then checks if there is another variable after the SET command and, if there is, the above routine is repeated.

Any number of variables may follow the SET command



Flowchart of the SET routine.

and the command can appear anywhere in the program eg.
30 SET A, @ (A), B; IF B=6 SET C

Sample Program

```
10 POKE 5234, 8164; POKE 5142,0; POKE 5249, 8026
20 DATA 1,2,3,4,5
30 DATA 6,7,8,9,10,11
40 SET A; PRINT A,
50 IF A=7 RESTORE
60 GOTO 40
RUN
  1   2   3   4   5   6   7   1
  2   3   4   5   6   7   1   2 . . . etc.
```

Delete Line 50 and the program will RUN . . .

```
  1   2   3   4   5   6   7   8
  9   10   11
```

```
SORRY
40 SET ?A; PRINT A,
```

Delete Lines 20 and 30 and the program will RUN . . .

```
HOW?
40 SET? A; PRINT A,
```

The additional POKE command in line 10 (POKE 5249, 8026) sets the amount of memory available to BASIC, to protect the m/c routine from an 'over-sized' array.

As a second example in using the commands, try this:

```
10 POKE 5234, 8164; POKE 5142,0; POKE 5249, 8026
20 DATA 68,65,84,65,32,67,79,77,77,65,78,68,32,82
25 DATA 69,65,68,89,13,79,75,63,13
30 FOR I=1 TO 23
40 SET A; VDU 0,A
50 NEXT I
RUN
```

Program Listing

```
1410    DATA INIT:      Address of start of Data string.
1412    DATA PLACE:     Current position in Data string.
1414    DATA LN:        Address of Data Line Number.
1416    DATAWORD:       Flags if Data is present in text.

1F5A  3A 16 14    SET:    LDA   DATAWORD
1F5D  FE 01               CPI   01
1F5F  C2 FB 09            JNZ   QHOW
1F62  CD 8B 09    SET 1:  CALL  TSTV
1F65  DA 32 09            JC    QWHAT
1F68  D5                  PUSH  D
1F69  E5                  PUSH  H
1F6A  2A B7 14            LHLD  CURRNT
1F6D  E5                  PUSH  H
1F6E  2A 14 14    SET 2:  LHLD  DATA LN
1F71  22 B7 14            SHLD  CURRNT
1F74  2A 12 14            LHLD  DATA PLACE
1F77  7E                  MOV   A,M
1F78  FE 0D               CPI   'cr'
1F7A  CA 9E 1F            JZ    MORE
1F7D  FE 2C               CPI   ','
1F7F  C2 83 1F            JNZ   SET 3
1F82  23                  INX   H
1F83  EB          SET 3:  XCHG
1F84  CD 5D 07            CALL  EXPR
1F87  EB                  XCHG
1F88  22 12 14            SHLD  DATA PLACE
1F8B  E1                  POP   H
1F8C  22 B7 14            SHLD  CURRNT
1F8F  E1                  POP   H
1F90  73                  MOV   M,E
1F91  23                  INX   H
1F92  72                  MOV   M,D
1F93  D1                  POP   D
1F94  1A                  LDAX  D
1F95  FE 2C               CPI   '?'
1F97  C2 0B 09            JNZ   FINISH
1F9A  13                  INX   D
1F9B  C3 62 1F            JMP   SET 1
1F9E  23          MORE:   INX   H
1F9F  22 14 14            SHLD  DATA LN
1FA2  23                  INX   H
1FA3  23                  INX   H
1FA4  7E                  MOV   A,M
1FA5  FE 44               CPI   'D'
1FA7  C2 B7 1F            JNZ   ERROR
1FAA  23          MORE1:  INX   H
1FAB  7E                  MOV   A,M
1FAC  FE 3A               CPI   3A H
1FAE  D2 AA 1F            JNC   MORE 1
1FB1  22 12 14            SHLD  DATA PLACE
1FB4  C3 6E 1F            JMP   SET 2
1FB7  E1          ERROR:  POP   H
1FB8  22 B7 14            SHLD  CURRNT
1FBB  E1                  POP   H
1FBC  C3 60 09            JMP   A SORRY
1FBF  21 16 14    DATA:   LXI   H,DATAWORD
1FC2  7E                  MOV   A,M
1FC3  FE 01               CPI   01
1FC5  CA CC 06            JZ    REM
1FC8  36 01               MVI   M,01
1FCA  2A B7 14            LHLD  CURRNT
1FCD  22 14 14            SHLD  DATA LN
1FD0  EB                  XCHG
1FD1  22 10 14            SHLD  DATA INIT
1FD4  22 12 14            SHLD  DATA PLACE
1FD7  EB                  XCHG
1FD8  C3 CC 06            JMP   REM
1FDB  2A 10 14    RESTORE: LHLD  DATA INIT
1FDE  22 12 14             SHLD  DATA PLACE
1FE1  C3 0B 09             JMP   FINISH
1FE4  21 E9 1F    MOREC:  LXI   H,TAB 7-1
1FE7  C3 D1 04            JMP   EXEC
1FEA  52 45 53 54
      4F 52 45    TAB 7:        'RESTORE'
1FF1  9F DB
1FF3  44 41 54 41             'DATA'
1FF7  9F BF
1FF9  53 45 54                'SET'
1FFC  9F 5A
1FFE  87 49                   ADDR DEFLT
```

In BASIC:

```
10 POKE 5234, 8164; POKE 5142, 0; POKE 5249, 8026
```

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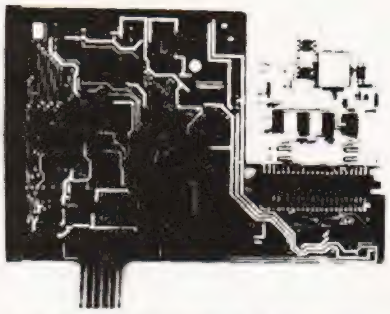

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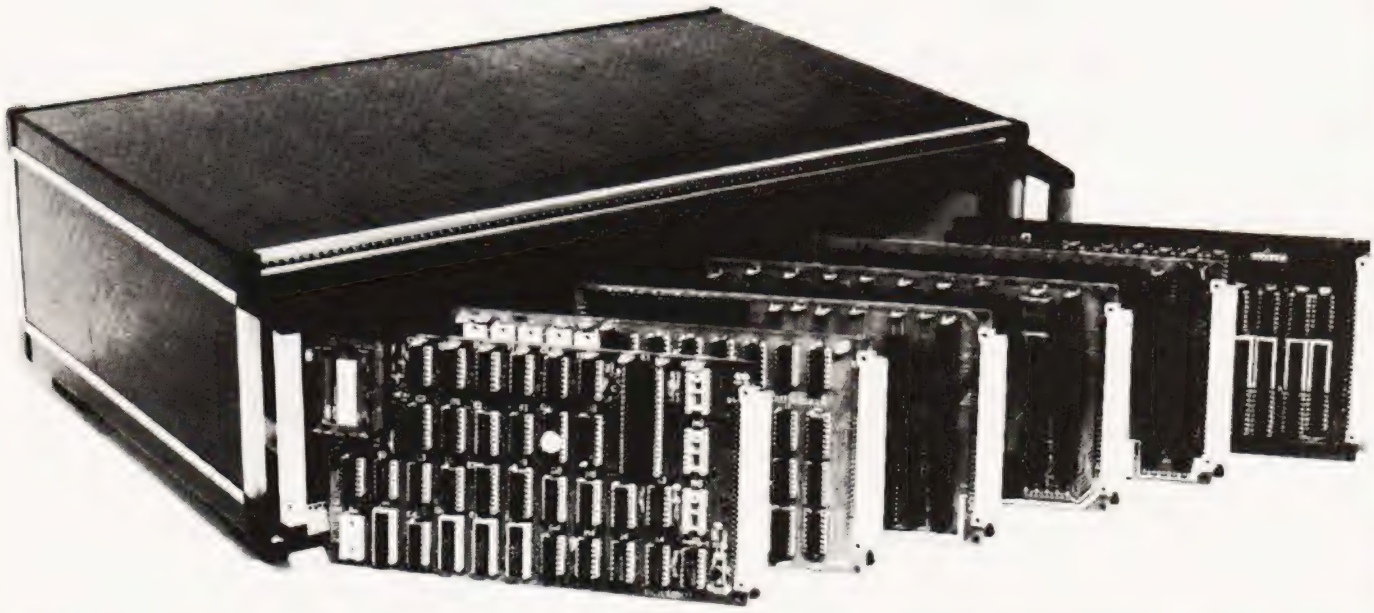

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Avoid the rigours of machine code with some useful hints on how to make things go faster, BASICally that is.

PROGRAMMING FOR SPEED

Malcolm Banthorpe

The flexibility of BASIC, as a programming language allows the programmer considerable freedom in choosing the exact manner in which a particular task will be tackled. There will often be a number of different approaches available for the writing of even a simple routine, all of which achieve the same end result but via different sequences of instructions. The readability of the program, the amount of memory used, the accuracy of the result, the ease of use of the program, its ability to deal with 'rogue' data and its speed of execution will all vary according to which approach has been adopted.

Programmer's Criteria

Generally the most important criteria of good programming are ease of use, accuracy of result, ability to deal with rogue data and user errors, and readability. By readability we mean the degree to which the program listing can be understood by someone other than its author. This factor is important even in home computing where a program listing may be intended only for the eyes of its writer. Most programmers will have experienced the frustration of trying to decode one of their own programs several months or even weeks after it was written.

In graphics programs where animation is involved, such as in games and simulations, the situation is rather different and in order to achieve an effective display it is often necessary to program for speed at the expense of other considerations, readability in particular. Games such as 'Breakout', 'Space Invaders', Pinball etc. which rely heavily on animated graphics are ideally programmed at least partially in machine code to give the necessary speed. Many home programmers are happier working with BASIC and good results can often be achieved if care is taken in writing those parts of the program where speed is most critical. Real time control is another area where the execution time of a routine can be of paramount importance.

Timesaving Techniques

This article describes a number of techniques which may be applied to BASIC programs to minimise processing time. Their use is by no means restricted to games and control applications but it should be borne in mind that the speed is often won at the expense of readability.

A graphics animation routine typically employs one or more loops to achieve the illusion of movement of a graphic character on the VDU screen. The symbol is repeatedly written onto the screen, erased and rewritten into an adjacent location. If this can be done quickly enough there is a reasonably good illusion of movement. If the program loop is too slow the sequence of events will be seen for what it really is, namely a symbol constantly appearing and then disappearing to reappear slightly shifted and the illusion is lost. It is the way in which the program instructions within these loops are written that will determine the success or failure of the animation. The loops will contain the rules which apply to the movement and will also test for collisions etc. and modify the movement accordingly. In all the following programming examples, FOR. . . NEXT loops are used to compare the execution times of pairs of routines which achieve the same results by different means. The examples were run and timed on an ITT 2020 and similar results can be expected on any machine which has a Microsoft type of BASIC interpreter.

Number One

The first technique is a fairly obvious one which is often neglected by beginners. This is not purely a speed-up technique but should be applied to all programming. The rule is simply to avoid placing in a loop any instruction which only needs to be carried out once. Consider the following routine:-

```
a) 10 FOR Y = 1 TO 32
   20 FOR X = 1 TO 64
   30 Q = SQR (X↑2 + Y↑2)
   40 NEXT X
   50 NEXT Y
  (execution time 298 S)
```

In this rather slow routine (the SQR and ↑ functions tend to slow down any routine as will be shown later), Y↑2 is evaluated 2048 times in line 30 when it only need be evaluated 32 times if placed outside the inner loop, since the value of Y only changes 32 times during the execution of the routine.

```
b) 10 FOR Y = 1 TO 32
   15 Y2 = Y↑2
   20 FOR X = 1 TO 64
   30 Q = SQR (Y2 + X↑2)
   40 NEXT X
   50 NEXT Y
  (execution time 202 S)
```

The additon of line 15 and the modification to line 30 has reduced the execution time by nearly one third. The value of X↑2 must still be calculated 2048 times because the value of X changes 64 times for each of the 32 times that Y changes.

Timed Twice

Where a constant is to be used several times, such as in a loop, set a variable to be equal to the constant before the loop and thereafter use the variable.

```
c) 10 FOR X = 1 TO 30
   20 P = P + 1
   30 NEXT X
  (execution time 12.4 S)

d)  5 A = 1
   10 FOR X = 1 TO 3000
   20 P = P + A
   30 NEXT X
  (execution time 11.3 S)
```

Simply by setting A to be equal to 1 in line 5 and modifying line 20 a significant reduction in the execution time has been

made. The BASIC interpreter takes less time to look up the value of A in its variable table than it does to convert one or any other number from the floating point decimal form to the binary form which it uses internally. So in this case the conversion is only required once in line 5 instead of 3000 times as in example c). The technique can give significant speed gains, especially where several such constants are involved in a loop.

Technique Three

In NEXT statements it is generally permissible to omit the index variable. This does tend to degrade program readability somewhat but can be useful where speed is critical.

```
e) 10 FOR X = 1 TO 5000
     20 NEXT X
   (execution time 6.6 S)

f) 10 FOR X
     20 NEXT
   (execution time 5.5 S)
```

The omission of the index variable, X, from line 20 gives a speed gain of nearly 20%. NEXT is faster than NEXT X because in the former case the computer does not check that X was variable specified in the last FOR. . . TO statement. This information is already stored on the stack and even where several FOR. . . NEXT loops are nested, the computer will execute them in the correct sequence without the variable being specified in each NEXT statement. A few dialects of BASIC will not accept this form of statement and will indicate a syntax error. Check that it is compatible with your computer by running example f).

More On FOR

Addition and subtraction are performed more quickly than multiplication and division and these in turn are performed faster than functions such as ↑, SQR, SIN, LOG etc. Often alternate functions can be implemented to achieve the same result but with a saving of time.

```
g) 10 B = 2
     20 FOR A = 1 TO 3000
     30 C = A*B
     40 NEXT
   (execution time 12.6 S)

h) 20 FOR A = 1 TO = 3000
     30 C = A + A
     40 NEXT
   (execution time 9.7 S)
```

Both routines are involved with the doubling of the value of A but h) is faster because it uses addition instead of multiplication to achieve this end. If B is set to 3 in line 10 of g) and line 30 of h) is changed to C = A+A+A then the run time becomes 12.6 seconds in each case showing that the extra addition operation cancels the previous advantage and that the technique is only beneficial where doubling is involved.

The Fifth Amendment

As mentioned previously, BASIC is particularly slow in evaluating powers of numbers when the ↑ function is used. Where the power in question is an integer, it is often advantageous to use multiplication instead.

```
i) 10 FOR X = 1 TO 1000
     20 A = X↑2
     30 NEXT
   (execution time 52.9 S)

j) 10 FOR X = 1 TO 1000
     20 A = X*X
     30 NEXT
   (execution time 4.5 S)
```

The time difference here is very large and would make an obvious improvement to the speed of an animation. The squaring of numbers is of use in such a program for the calculation of distances using Pythagoras' Theorem [C = SQR(A*A + B*B)]. Even higher powers can profitably be calculated by multiplication. If line 20 in the above examples is changed as follows,

```
i) 20 A = X↑5

j) 20 A = X*X*X*X*X
```

then the execution times are 52.0 and 10.7 S respectively, showing that multiplication still has the clear advantage despite the extra arithmetic operations.

The SQR function, which is also slow, is unfortunately not so easy to deal with. There is no straightforward alternative to the SQR function. Where it has to be used and is seriously affecting the success of a program, the one possible solution may be to use a look-up table for the values of the square roots. Those required can be evaluated at the start of the program and stored in an array:-

```
k) 10 DIM S (200)
     20 FOR X = 1 TO 200
     30 S (X) = SQR (X)
     40 NEXT
```

This routine, although slow, can be run once and for all at the start of the program. Subsequently, the value of a square root of an integer in the range 1 to 200, can be looked up directly in the array in the time-critical part of the program eg:-

```
l) 50 FOR X = 1 TO 200
     60 A = S(X)
     70 NEXT
   (execution time 1.0 S)
```

Compare this with the execution time of 10.5 seconds when line 60 is changed to A = SQR(X).

This technique is useful where a limited range of roots is required, but is extravagant in its use of memory because of the array space required. It may be possible to reduce this requirement by the use of an integer array instead of a real array, if available on your computer. An integer array (in Palsoft BASIC as used on the ITT 2020) uses only two bytes per element compared to five bytes per element for an array of real (10 digit floating point) numbers.

If this technique was to be applied to program example a) then it could most simply be implemented by using a two dimensional array. The routine to set up the table of roots

would be of the form:-

```
m) 1 DIM S (64,32)
   2 FOR X = 1 TO 64
   3 X2 = X*X
   4 FOR Y = 1 TO 32
   5 S(X,Y) = SQR( X2 + Y*Y)
   6 NEXT
   7 NEXT
```

Program a) can now be rewritten to incorporate all the speed — up techniques mentioned so far which are relevant to it.

```
n) 10 FOR Y = 1 TO 32
   20 FOR X = 1 TO 64
   30 Q = S(X,Y)
   40 NEXT
   50 NEXT
```

(execution time 14.1 S)

The big improvement in execution time over the previous 202 seconds is mainly due to the use of the array to eliminate the need for the ↑ and SQR functions.

Added Extras

There are a number of further techniques which will have a lesser effect on speed but which may however be useful in fine tuning a program. Variables are stored in a variable table by the BASIC interpreter in the order which they are first encountered in a program. Hence if the first line of a program is:-

```
10 A = 5: B = 7
```

then A becomes the first variable in the table and however often its value changes as the program is run it remains at the top of the table. Similarly B will be the second variable in the table. Each time a particular value is specified during a program the interpreter will search through its table, starting at the top until it is found. Some time can therefore be saved by declaring near to the start of a program any variables which are later to be specified frequently. Then, each time the variable is encountered the search is minimised.

In very long programs it may be worthwhile to place any subroutines which are to be frequently called, near the beginning. This is contrary to normal practice where subroutines are normally placed after the main body of the program. When the interpreter encounters an instruction such as GOSUB 1000 it will look at every line number from the start of the program until line 1000 is found. Therefore the nearer to the start of a program a subroutine is placed, the less the search time on each occasion that it is called.

The use of multiple statements instead of one statement per line will have a very minimal effect on run time and is not generally worthwhile for speed considerations alone.

Any of the above techniques can be applied to reduce the running time of critical parts of your programs. Individually some procedures will have very little effect, but used in combination they can improve a program considerably.

OPTIMISATION IN BASIC

D. Bolton

This article is devoted to saving both memory and execution time of BASIC programs running on the Commodore PET. Many of the tips are applicable to other micros and languages.

Optimisation can be achieved in several areas; program control flow, data storage, numerical methods and strings.

Program Control Flow

All BASIC programs execute statements one after another until a break in the flow is made and a branch occurs. On most interpreted BASICs, GOTOs and GOSUBs take place by searching the program for the designated line-number. The search naturally begins at the start of the program and therefore takes longer in larger programs. Two methods suggest themselves for speeding up programs. First, make the program shorter and, secondly, reduce the number of branches. A good idea for achieving the latter is to break the program into a number of blocks (*not subroutines*), each having only one entrance and only one exit.

Subroutines which are called very frequently will contribute a noticeable time-saving if they are put near the start of the program. This might go against the 'standards' of 'respectable' programming, but it is definitely faster. Something on the lines of

```
1 GOTO 25
2 (Fast Subroutines)
24 (End of fast subroutines)
25 (Rest of main program)
```

The following ideas will each reduce the size of a program by a few bytes and together can make a significant space and time saving.

Squashing It Up

Always use variables instead of constants. For example set P = 3.141596 (for those BASICs without PI). Every reference to P saves seven bytes and it is faster to fetch the value from a variable than to have to read it as a constant.

Remove all superfluous spaces and REM statements. With three spaces between the '=' and 'C' in line 3, the program takes half a second longer. Please note however that Editors like spaces so they can actually read your submitted programs.

Each line in a program has an overhead of five bytes (two for the line-number, two for the link address and one for the end of line) so compressing the statements and thus removing lines is good for speed, though it can make a program unreadable to others. 427 lines of totally compressed program takes up 15K on the PET.

Microsoft BASICs allow NEXT statements without specifying the variable. This will save a byte or two, but can be awkward under certain circumstances, such as a jump out of a FOR-NEXT loop. Because no check is made upon the variable the last unfinished loop will be completed. This space-saver is perhaps best left until a program is nearly completed. The other advantage of NEXT statements without variables is that they are faster.

Those with the 'TOOLKIT' or some other renumbering device can make improvements upon a finished program by renumbering in steps of one starting at line 1. This is because the

line-numbers in GOTO (etc.) statements are held in character form. For example, 2000 takes up four characters, while 200 takes three. Typical saving for a 15K program thus renumbered is an amazing 500 bytes.

While talking about the TOOLKIT, its presence when 'switched on' effects the speed of the PET, slowing it down to 5/6ths speed. When development is finished don't use it. Any 6502 routines which 'poach' input in a similar fashion will also have a detrimental effect on speed.

Finally, in this section, do any of your subroutines finish off with a call to another subroutine?

```
100 GOSUB 2000: RETURN
```

These can all be altered to 100 GOTO 2000. Obvious to some, perhaps not to everyone.

Data Storage

This section is concerned with efficient use of storage rather than execution time, though one *can* follow from the other.

Integers are only better when large arrays are used. A single variable occupies seven bytes, though only two hold its value. Real numbers with whole values will process just as fast and in some cases quicker than integers. This is because A is physically shorter than A%. Non-string arrays occur in the memory map directly after the simple variables and, if a new variable occurs, then all of these arrays have to be moved down seven bytes in the memory.

In the table of simple variables, their presence or lack of it is detected every time a variable is referred to in the program. For quickest execution, those frequently used variables should be defined as early as possible in the program, perhaps with dummy values.

Integer arrays can hold numbers outside the range — 32768 to 32767 providing two conditions are met. These are that the numbers are all whole numbers and that their range (highest — lowest) is under 65536.

For example consider 427654, 442501, 451002 and 488814. A compensating factor (CF) is found by adding 32768 to the first item. CF is then subtracted from all of the list items to give their integer values.

Obviously this method has its limitations but it has been used successfully in a sales ledger, where up to a thousand invoice-numbers have to be in RAM at the same time. The savings are very worthwhile.

By lowering the amount of memory that the PET thinks it has, one can produce a safe section of RAM which will not be touched by the program. Single byte numbers (range 0-255) can be POKEd and PEEKed into this area allowing up to one 30,000 element array. Lowering allocated memory space can be achieved by calculating the new 'top of memory' address and converting this into two values which are POKEd into locations 52 & 53 (New ROMs) or 134 & 135 (Old 8K ROMs).

Strings

This final section has been separated from data storage because strings (on the PET anyway) have some eccentricities.

Before we go on I have to define what is meant by 'free' memory. This is the area which is not used to hold any data and lies above the numeric arrays and below the strings in the memory map. When a FRE(0) is performed, this indicates how many bytes of 'free' memory are left.

Free memory is used to contain strings when an output or concatenation takes place. The PET stores strings in two places. One part contains the variable name, length and pointers to string memory where the string itself lives. String memory expands down into free memory as various operations are done but in an assignment say B$ = B$ + C$ the old value of B$ is *not* destroyed. This is because in a statement like A$ = B$, the pointers in A$ are set to those in B$ and both share the same string. To be able to destroy an old string would involve a search of all strings to find if they were 'sharing'. A search for every assignment would be terribly slow. When 'free' memory is full then a 'Garbage Collection' takes place and moves all the allocated strings to the top of memory thus making free space available again.

The trouble is that a Garbage Collection can take a great deal of time. It really depends on the number of strings in use at the same time. Worst cases can be over 20 minutes in which the PET just sits there!

If you use a lot of strings then you are going to have to accept the inevitable. Nothing can be done about the time needed for a Garbage Collection, but a bit of forethought can reduce the frequency of their occurences.

A fairly common example will illustrate the problem, build up a string of 100 spaces for later use

```
10 A$ = " ":FOR I = 1 TO 1000:A$ = A$ + " ":NEXT
```

That simple little operation takes a fraction of a second and uses up 5K of free memory! The sum of 1 + 2 + 3 . . . + 100 = 5050.

Try the following.

```
DIM A$(500):FOR I = 1 TO 500:A$(I) = " [10 SPC ]":
NEXT
```

and then type

```
A = TI:PRINT FRE(0),INT((TI − A)/.6)/100
```

After a while two figures will appear. The first is the amount of free memory and the second is the time in seconds for the "Collection". Now type CLR and try bigger values for the size of A$.

Some hints for decreasing the frequency of Garbage Collections. Have as much free memory as possible, using those methods stated earlier. If your program uses large amounts of DATA in DATA statements then consider using cassette or disc files for storing it. For every line of DATA removed there is an overall saving of 6 bytes, plus the physical data removed. When information is no longer need destroy it. Consider an array holding the days of the week and months of the year. Once the array is no longer needed then over 120 bytes of memory are tied up containing the data. A short loop setting all the elements to a null value will free the 120 bytes after the next Garbage Collection.

For a variety of reasons, it sometimes occurs that strings have to be padded out to a common length. There are two methods of doing this.

1/Use a FOR-NEXT loop to append spaces.

```
FOR I= 1 TO 25 − LEN(A$):A$ = A$ + " ":NEXT
```

2/Use of LEFT$

```
A$=A$+LEFT$(SP$,25−LEN(A$))
```

The second method assumes the existence of the string SP$ containing at least 25 spaces. It is by far the better of the two as it is quicker, always works for A$ greater in length, it is shorter to write and doesn't use up to 325 bytes (worst case) of free memory, as the first one does.

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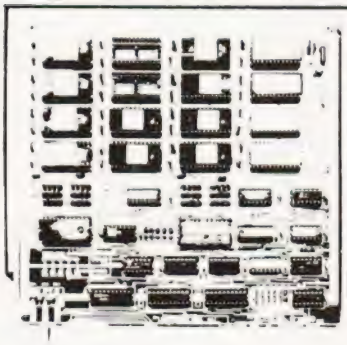

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As promised, Graphic Details is back with more of the same. However, a confession is due. In the last feature we gave the details on the Sharp MZ-80K but although 'correct' they weren't quite the right ones! Confused by the Japanese English we managed to give you the ASCII set so, by way of compensation here are the 'details' again correct (we hope).

Standard Codes

One of the commonly asked questions is 'how can we give the cursor movements?' The answer is simple, you use the standard set of character codes that CT has developed. These are as follows.

CU Cursor Up
CD Cursor Down
CL Cursor Left
CR Cursor Right
HOM Cursor Home
CLS Clear Screen
SPC Space

To indicate that these are not part of the computer program we always enclose them in square brackets, most systems will generate a Syntax Error if you try to run a program without converting them into something more sensible. This idea has been expanded to include graphics as well, simply because many people don't possess printers that can draw them.

To indicate the appropriate graphics character for a machine such as the Sharp MZ-80K the following procedure is used. Each key is fitted with a graphic legend that corresponds to the graphic that will be produced when that key is pressed in the 'graphics' mode. The 'heart' symbol for example is on the 'S' key. To indicate that you want the heart you write it as [↑ S].

With both the graphics and the cursor codes you can indicate multiple entries by inserting a number, [12 CD] would mean 'twelve Cursor Downs'. If you wish to clarify the graphics by means of a REM statement do make it clear which lines you are referring to, an even better method is to use a short table at the beginning of the program, or as part of the description.

Footnote

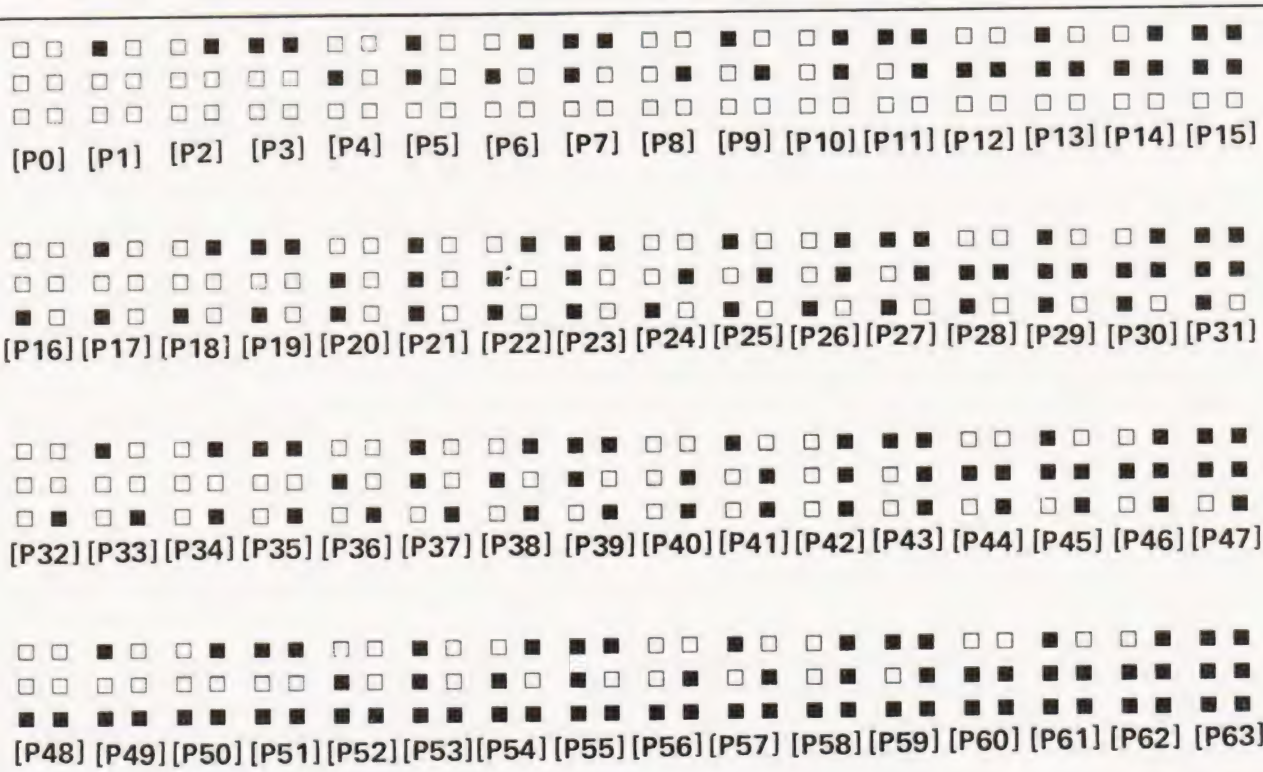
These tables are all compiled with the help of the computer manufacturers' data but some companies seem to be very slow in submitting the information. If you own a machine that has not been featured and you think that it should be then please contact us with the details.

Sharp MZ-80K

Screen Memory:- 53248-54247
D000H-D3E7H

Format:- 25 lines of 40 characters

Notes:- Taking the top left hand corner of the screen as co-ordinate 0,0 the commands SET and RESET can be used to turn on or off any cell on a 50 by 80 grid thus allowing limited double density plotting. Normal graphic codes are accessed by POKE, CHR$(198) performs a [CLS].



Pixel Codes

The above codes are generated within each character space as "chunky" graphics. We have given them each a "standard" code for future use.

GRAPHIC DETAILS

Code	Symbol	Code	Symbol	Code	Symbol	Code	Symbol	Code	Symbol	Code	Symbol	Code	Symbol	Code	Symbol
0	SP	32	0	64	SP	96	7L	128	SP	160		192		224	
1	A	33	1	65		97	!	129	a	161		193		225	
2	B	34	2	66		98	"	130	b	162		194		226	
3	C	35	3	67		99	#	131	c	163		195		227	
4	D	36	4	68		100	$	132	d	164		196		228	
5	E	37	5	69		101	%	133	e	165		197		229	
6	F	38	6	70		102	&	134	f	166		198		230	
7	G	39	7	71		103	'	135	g	167		199		231	
8	H	40	8	72		104	(	136	h	168		200		232	
9	I	41	9	73		105	)	137	i	169		201		233	
10	J	42	-	74		106	+	138	j	170	ß	202		234	
11	K	43	=	75		107	*	139	k	171	ü	203		235	
12	L	44	;	76		108		140	l	172	ö	204		236	
13	M	45	/	77		109		141	m	173	Ü	205		237	
14	N	46	.	78		110		142	n	174	Ä	206		238	
15	O	47	,	79		111		143	o	175	Ö	207		239	
16	P	48		80		112		144	p	176		208		240	SP
17	Q	49		81		113		145	q	177		209		241	
18	R	50		82		114		146	r	178		210		242	
19	S	51		83		115		147	s	179		211		243	
20	T	52		84		116		148	t	180		212		244	
21	U	53		85	@	117		149	u	181		213		245	
22	V	54		86		118		150	v	182		214		246	
23	W	55		87		119		151	w	183		215		247	
24	X	56		88		120		152	x	184		216		248	
25	Y	57		89		121		153	y	185		217		249	
26	Z	58		90		122		154	z	186		218		250	
27	£	59		91		123		155	ä	187		219	o	251	
28		60		92		124		156		188		220		252	
29		61		93		125		157		189		221		253	
30		62		94		126		158		190		222		254	
31		63		95		127		159		191		223		255	

Note: SP represents a space or blank.

CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL
0		32		64	@	96		128		160		192		224	
1		33	!	65	A	97		129		161		193		225	
2		34	"	66	B	98		130		162		194		226	
3		35	#	67	C	99		131		163		195		227	
4		36	$	68	D	100		132		164		196		228	
5		37	%	69	E	101		133		165		197		229	
6		38	&	70	F	102		134		166		198		230	
7		39	'	71	G	103		135		167		199		231	
8		40	(	72	H	104		136		168		200		232	
9		41	)	73	I	105		137		169		201		233	
10		42	*	74	J	106		138		170		202		234	
11		43	+	75	K	107		139		171		203		235	
12		44	,	76	L	108		140		172		204		236	
13		45	—	77	M	109		141		173		205		237	
14		46	.	78	N	110		142		174		206		238	
15		47	/	79	O	111		143		175		207		239	
16		48	0	80	P	112		144		176		208		240	
17		49	1	81	Q	113		145		177		209		241	
18		50	2	82	R	114		146		178		210		242	
19		51	3	83	S	115		147		179		211		243	
20		52	4	84	T	116		148		180		212		244	
21		53	5	85	U	117		149		181		213		245	
22		54	6	86	V	118		150		182		214		246	
23		55	7	87	W	119		151		183		215		247	
24		56	8	88	X	120		152		184		216		248	
25		57	9	89	Y	121		153		185		217		249	
26		58	:	90	Z	122		154		186		218		250	
27		59	;	91	[	123		155		187		219		251	
28		60	<	92	\	124		156		188		220		252	
29		61	=	93	]	125		157		189		221		253	
30		62	>	94	↑	126		158		190		222		254	
31		63	?	95		127		159		191		223		255	

TRITON

Screen memory:- 4096-5119
1000H-13FFH

Format:- 16 lines of 64 characters

Notes:- Direct access is available to the VDU control chip with the VDU 0,n command in BASIC where n is one of a number of control codes. Some useful ones are; 8-Backspace, 9-Cursor right, 10-Line feed, 11-Cursor up, 12-Clear screen, 13-Carriage return erasing remainder of line, 27-Scrolling line feed, 28-Home cursor and 29-non destructive carriage return. Normal screen access is by the VDU x,y format where x is the position and y is the selected character. On some early versions of the TRITON you must have a delay after clearing the screen, a 150 FOR . . . NEXT loop normally suffices.

GRAPHIC DETAILS

CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL	CODE	SYM-BOL
0		32	SP	64	@	96		128		160	SP	192		224	
1		33	!	65	A	97	a	129		161		193		225	
2		34	"	66	B	98	b	130		162		194		226	
3		35	#	67	C	99	c	131		163		195		227	
4		36	$	68	D	100	d	132		164		196		228	
5		37	%	69	E	101	e	133		165		197		229	
6		38	&	70	F	102	f	134		166		198		230	
7		39	'	71	G	103	g	135		167		199		231	
8		40	(	72	H	104	h	136		168		200		232	
9		41	)	73	I	105	i	137		169		201		233	
10		42	*	74	J	106	j	138		170		202		234	
11		43	+	75	K	107	k	139		171		203		235	
12		44	,	76	L	108	l	140		172		204		236	
13		45	-	77	M	109	m	141		173		205		237	
14		46	.	78	N	110	n	142		174		206		238	
15		47	/	79	O	111	o	143		175		207		239	
16		48	0	80	P	112	p	144		176		208		240	
17		49	1	81	Q	113	q	145		177		209		241	
18		50	2	82	R	114	r	146		178		210		242	
19		51	3	83	S	115	s	147		179		211		243	
20		52	4	84	T	116	t	148		180		212		244	
21		53	5	85	U	117	u	149		181		213		245	
22		54	6	86	V	118	v	150		182		214		246	
23		55	7	87	W	119	w	151		183		215		247	
24		56	8	88	X	120	x	152		184		216		248	
25		57	9	89	Y	121	y	153		185		217		249	
26		58	:	90	Z	122	z	154		186		218		250	
27		59	;	91	[	123	{	155		187		219		251	
28		60	<	92	\	124	¦	156		188		220		252	
29		61	=	93	]	125	}	157		189		221		253	
30		62	>	94	↑	126	~	158		190		222		254	
31		63	?	95	_	127		159		191		223		255	

PIXEL CHARACTERS

PIXEL CHARACTERS

NASCOM

Screen memory:- 2048 - 3071
0800H-0BFFH

Format:- 16 lines by 48 characters

Notes:- A total of 256 bytes of video RAM are lost in the margins and should not be accessed by the user. These are the initial ten locations (0800H-0809H) and the last six (0BFAH-0BFFH) as well as 15 groups of 16 bytes between each line. The top line of the display is not scrolled and may be used for titles etc. The top line addresses follow on from those of the bottom line which can cause problems for the unwary. The NASCOM 2 offers an optional on-board graphics set whose codes are from 128 up.

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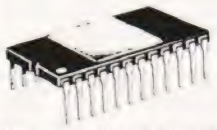

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LS12	32	LS390	140
LS13	40	LS393	140
LS14	75	LS395	210
LS15	40	LS396	199
LS20	24	LS398	275
LS21	32	LS399	230
LS22	40	LS445	140
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LS30	24	LS669	105
LS32	30	LS670	270
LS33	39		
LS37	39		
LS38	39		
LS40	28		
LS42	80		
LS47	85		
LS48	120		
LS49	120		
LS51	25		
LS54	30		
LS55	70		
LS63	150		
LS73	40		
LS74	40		
LS75	48		
LS76	45		
LS78	45		
LS83	105		
LS85	105		
LS86	45		
LS90	50		
LS91	125		
LS93	75		
LS95	115		
LS96	180		
LS107	45		
LS109	75		
LS112	80		
LS113	65		
LS114	49		
LS122	70		
LS123	95		
LS124	180		
LS125	60		
LS126	60		
LS132	95		
LS133	30		
LS136	55		
LS138	70		
LS139	90		
LS145	120		
LS148	175		
LS151	95		
LS153	85		
LS155	95		
LS156	95		
LS157	75		
LS158	85		
LS160	120		
LS161	95		
LS162	110		
LS163	100		
LS164	115		
LS165	155		
LS166	175		
LS168	210		
LS169	210		
LS170	288		
LS173	105		
LS174	147		
LS175	110		
LS181	295		
LS190	120		
LS191	120		
LS192	125		
LS193	125		
LS194	125		
LS195	125		
LS196	120		
LS202	345		
LS221	120		
LS240	225		
LS241	225		
LS242	232		
LS243	232		
LS244	225		
LS245	380		
LS247	135		
LS248	135		
LS249	135		
LS251	130		
LS253	130		
LS257	115		
LS258	120		
LS259	160		
LS261	450		
LS266	75		
LS273	180		
LS275	320		
LS279	89		
LS280	250		
LS283	190		
LS290	130		
LS293	130		
LS296	215		
LS298	215		
LS299	420		
LS324	200		
LS325	320		
LS326	330		
LS327	315		
LS352	185		
LS353	185		
LS355	65		

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4006	92
4007	22
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4009	40
4010	48
4011	24
4012	24
4013	45
4014	86
4015	86
4016	42
4017	82
4018	28
4019	48
4020	99
4021	106
4022	95
4023	25
4024	75
4025	25
4026	180
4027	48
4028	82
4029	106
4030	60
4033	175
4034	210
4035	125
4040	105
4041	80
4042	80
4043	95
4044	95
4046	130
4047	98
4049	45
4050	48
4051	80
4052	80
4053	80
4054	130
4056	135
4068	26
4069	28
4070	30
4071	25
4072	25
4073	25
4075	25
4076	99
4078	30
4081	28
4093	89
4502	125
4507	60
4508	325
4510	99
4511	150
4512	[illegible]
4514	21
4515	299
4516	120
4518	105
4519	70
4520	115
4521	250
4522	150
4526	150
4527	180
4528	120

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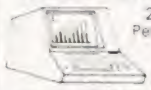

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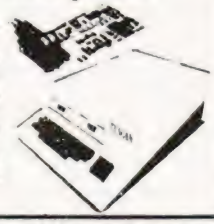

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TRANSAM

The Sinclair ZX80 is innovative and powerful. Now there's a magazine to help you get the most out of it.

Get in sync

SYNC magazine is different from other personal computing magazines. Not just different because it is about a unique computer, the Sinclair ZX80 (and kit version, the MicroAce). But different because of the creative and innovative philosophy of the editors.

A Fascinating Computer

The ZX80 doesn't have memory mapped video. Thus the screen goes blank when a key is pressed. To some reviewers this is a disadvantage. To our editors this is a challenge. One suggested that games could be written to take advantage of the screen blanking. For example, how about a game where characters and graphic symbols move around the screen while it is blanked? The object would be to crack the secret code governing the movements. Voila! A new game like Mastermind or Black Box uniquely for the ZX80.

We made some interesting discoveries soon after setting up the machine. For instance, the CHR$ function is not limited to a value between 0 and 255, but cycles repeatedly through the code. CHR$ (9) and CHR$ (265) will produce identical values. In other words, CHR$ operates in a MOD 256 fashion. We found that the "=" sign can be used several times on a single line, allowing the logical evaluation of variables. In the Sinclair, LET X=Y=Z=W is a valid expression.

Or consider the TL$ function which strips a string of its initial character. At first, we wondered what practical value it had. Then someone suggested it would be perfect for removing the dollar sign from numerical inputs.

Breakthroughs? Hardly. But indicative of the hints and kinds you'll find in every issue of **SYNC**. We intend to take the Sinclair to its limits and then push beyond, finding new tricks and tips, new applications, new ways to do what couldn't be done before. **SYNC** functions on many levels, with tutorials for the beginner and concepts that will keep the pros coming back for more. We'll show you how to duplicate commands available in other Basics. And, perhaps, how to do things that can't be done on other machines.

Many computer applications require that data be sorted. But did you realize there are over ten fundamentally different sorting algorithms? Many people settle for a simple bubble sort perhaps because it's described in so many programming manuals or because they've seen it in another program. However, sort routines such as heapsort or Shell-Metzner are over 100 times as fast as a bubble sort and may actually use less memory. Sure, 1K of memory isn't a lot to work with, but it can be stretched much further by using innovative, clever coding. You'll find this type of help in **SYNC**.

Lots of Games and Applications

Applications and software are the meat of **SYNC**. We recognize that along with useful, pragmatic applications, like financial analysis and graphing, you'll want games that are fun and challenging. In the charter issue of **SYNC** you'll find several games. Acey Ducey is a card game in which the dealer (the computer) deals two cards face up. You then have an option to bet depending upon whether you feel the next card dealt will have a value between the first two.

In Hurkle, another game in the charter issue, you have to find a happy little Hurkle who is hiding on a 10 X 10 grid. In response to your guesses, the Hurkle sends our a clue telling you in which direction to look next.

One of the most ancient forms of arithmetical puzzle is called a "boomerang." The oldest recorded example is that set down by Nicomachus in his *Arithmetica* around 100 A.D. You'll find a computer version of this puzzle in **SYNC**.

Hard-Hitting, Objective Evaluations

By selecting the ZX80 or MicroAce as your personal computer you've shown that you are an astute buyer looking for good performance, an innovative design and economical price. However, selecting software will not be easy. That's where **SYNC** comes in. **SYNC** evaluates software packages and other peripherals and doesn't just publish manufacturer descriptions. We put each package through its paces and give you an in-depth, objective report of its strengths and weaknesses.

SYNC is a Creative Computing publication. **Creative Computing** is the number 1 magazine of software and applications with nearly 100,000 circulation. The two most popular computer games books in the world, *Basic Computer Games* and *More Basic Computer Games* (combined sales over 500,000) are published by Creative Computing. Creative Computing Software manufactures over 150 software packages for six different personal computers.

Creative Computing, founded in 1974 by David Ahl, is a well-established firm committed to the future of personal computing. We expect the Sinclair ZX80 to be a highly successful computer and correspondingly, **SYNC** to be a respected and successful magazine.

Order SYNC Today

Right now we need all the help we can get. First of all, we'd like you to subscribe to **SYNC**. Subscriptions are posted by air directly from America and cost just £10 for one year (6 issues). £18 for two years (12 issues) or, if you really want to beat inflation, £25 for three years (18 issues). **SYNC** is available only by subscription; it is not on newsstands. We guarantee your satisfaction or we will refund the unfulfilled portion of your subscription.

Needless to say, we can't fill up all the pages without your help. So send in your programs, articles, hints and tips. Remember, illustrations and screen photos make a piece much more interesting. Send in your reviews of peripherals and software too—but be warned: reviews must be in-depth and objective. We want you to respect what you read on the pages of **SYNC** so be honest and forthright in the material you send us. Of course we pay for contributions—just don't expect to retire on it.

The exploration has begun. Join us.

The magazine for Sinclair ZX80 users

SYNC

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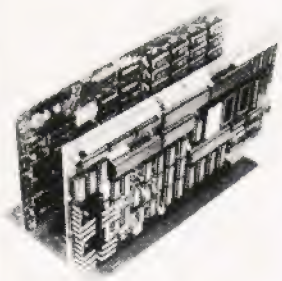
S100

Do You Have All These Facilities On Your S100 System, With Just Two Boards.?



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PRINTOUT

Dear Sir,

The following information may be useful to NASCOM and owners who are experiencing trouble with string manipulation in BASIC. The fault which is a corruption of string and numeric variables of the same name has been attributed (by NASCOM) to an uneven mark/space ratio in the clock signal of the Z80. This may be cured by swapping IC's in the clock chain (7, 11, 48 and 56) with similar devices elsewhere on the board or else if that fails, then connecting a 220 ohm resistor from pin 6 of IC11 to +5U and a 150pF capacitor from pin 6 of IC11 to OU should do the trick. Also memory plague may be the cause so you check for any signs of this.

Also I would like to announce the intended formation of a micro users group for the Doncaster area. The aim of the group is to provide an ideas forum for those people in the area who own micro's and to also provide lessons in BASIC programming for those who wish to learn but have no other access to a computer. Anyone who is interested should ring either Doncaster (0302) 784954 or Doncaster 868378 between 6pm and 9pm for further details.

Yours faithfully,
M.P. Flinders

205 Sprotbrough Road,
Doncaster,
South Yorkshire,
DN5 8BP

Dear Sir,

Ref. November issue of Computing Today

On Page 40 (Character Codes) you say that the following alphagraphic sets may be used with PEEK & POKE commands. However the Sharp MZ-80K listing on Page 44 is incorrect.

Referring now to the Sharp Basic Manual. You have printed the ASCII listing on Page 121. You *should* have printed the MZ-80K Display Table on Page 117 which is to be used with PEEK & POKE.

I enjoy your magazine. Please keep it simple and do not enter into the Practical Computing (Mumbo-Jumbo) high-powered stuff. Oh, yes and what about an editorial answer to each letter in "Printout"?

Yours faithfully,
Keith Faulkner,

13 Blake Close,
RAF Odiham,
Nr. Basingstoke,
Hants.

Dear Sir,

Readers of 'Computing Today' who are also owners of Level 1 TRS-80's might like to know of the existence of a national Level 1 User Group. The purpose of the group is to supply support and information concerning Level 1 machines exclusively, and this is done in the form of a regular newsletter. Software published in the newsletter is also available on cassette, for those who dislike typing.

Further details are available from myself at the address below. A stamp would be appreciated.

Yours faithfully,
N. Rushton

3 Roughwood Drive,
Northwood,
Kirkby,
Merseyside L33 9UG.

Computing Today,

Re — PRINTOUT

I am sure we have all at one time or another written programs and updated them so much that we have no room between line numbers.

After studying memory locations on my NASCOM with 8K BASIC, I eventually came up with a very simple Program which neatly converts all line numbers to increments of 10 e.g. 1, 3, 11, 13 will be 10, 20, 30, 40 after execution of this program.

The only snag (as it is such a simple program) is that Gosubs, Goto's etc. are not catered for. Hence you may have to search through and change them for yourself. I have used lines 10000 upward so as not to conflict with programs.

N = START ADDRESS OF BASIC PROGRAM
D = INCREMENT OF LINE NUMBER

P is the jump to the next line number. Line 10060 senses the start of this program.

Program to rewrite existing line numbers in increments of 10:

```
10000 N = 4346
10010 D = 10
10020 DOKE N+2,D
10030 P = DEEK (N) −N
10040 N = N + P
10050 D = D + 10
10060 IF DEEK (N + 2) = 100000
      THEN END
10070 GOTO 10020
```

P.S. If you put this in before you write your program, as you write your program, if you run 10000 every now and then, it will keep your program tidy as you go along.

Yours faithfully,
A. Christow,

14 Katie Rance Court,
Gorman Rd.
Woolwich,
SE18 SR2

Dear Sir,

Re: Mr. Jeremy Ruston's letter (Dec. '80).

Having made sketches for a kind of Assembler/Interpreter myself, I can testify that this kind of program is in the 8 — 12 K league and would produce bulky and slow routines because of the need for averaging routine requirements.

It is not difficult to produce such a program but on closer analysis one always finds two distinct requirements already catered for by 1) Assemblers, 2) BASIC Compilers.

You can take it from me that any attempt to superimpose these two on a micro creates more disappointment than it cures.

Yours faithfully,
Phillip L. Watson

101 Village Rd.,
Bromham,
Bedford.
MK42 8HU

Dear Sirs,

On behalf of my son Jacob I send you a print-out of the last part of a game of "Stockmarket", CT May 1980. As you can see, he ended up with a total of just under £300,000. As this is considerably more than the record of £229,000 mentioned in the description of the program, he would like to know what the present record is, and how he ranks among "Stockmarket"-players. Both of us would like to compliment the author, Anthony Fleet for the most impressing and exciting game we have seen so far for the TI-59.

Yours truly,
Claus Alsted,

Akademiingenior HD m.Ing.F.
Granparken 71,
Denmark

Dear Sir,

Let me reply to just a couple of the contentious points in Gordon Clyne's letter (December) on 'Computer Art'. They seem to reflect prevalent (and deeply appalling) attitudes, and are even sadder, coming from one with 'fine art' training.

1. 'Critics and tutors' are not put off such art because they think it's to do with pushing buttons, but because most of it is made by people with not the slightest feeling for, or knowledge of, art, and is thus invalid. (cf. 'Computer Music', 'Computer Poetry').

Give a boring artist a computer and you'll just get miles of boring art, usually silly bits of graphics that you could have done with a pencil and ruler, but if you had, no-one would look twice.

2. It's not in its infancy, it's been going for over 30 years now.

Yours faithfully,
Brian Reffin Smith,
Tutor in computing, R.C.A.

Royal College of Art
Kensington Gore,
London SW7 2EU.

Dear Sir,

I have entered Mr. Archer's "Mousetrap" game on my Video Genie, and I note that there are a few typographical errors in the listing given on page 21 of November's "Computing Today". The corrected lines are listed below:

```
10  CLS : PRINT @10, CHR$ (23); "****
    MOUSETRAP ****";: PRINT @ 454, "DO
    YOU WANT INSTRUCTIONS?"
70  FOR X = 0 TO 8 : SET (X,5) : NEXT
300 PRINT @ 800,"   ";:FOR X = 1 TO 200 :
    NEXT : NEXT
```

Although the manufacturers claim that the Video Genie is software compatible with the TRS-80 Level II, this is not strictly true. The four keys apparently used on the TRS-80 to play this game are not available on the Video Genie, however I have made a few modifications to the program and find it quite an addictive game. The mods I have made are:

```
110 M$ = INKEY$: IF M$ < > "" THEN 220
220 IF M$ = "S" THEN IF M < Z THEN
    M = M + 1 : SET (M, N) : GOTO 120
230 IF M$ = "Z" THEN IF N < D THEN N =
    N + 1 : SET (M, N) : GOTO 120
240 IF M$ = "W" THEN IF N > 1 THEN
    N = N−1 : SET (M, N) GOTO 120
250 IF M$ = "A" THEN IF M > 1 THEN M =
    M−1 : SET (M, N) : GOTO 120
260 (deleted)
```

This enables the line to be drawn using keys S, Z, W, and A. Removing line 260 removes the facility to rub out the line. In my opinion, this improves the game. The instructions given in line 390,400, and 420 also need to be changed to suit.

Yours faithfully,
A.A. Huntington,

49 Birch Tree Avenue,
West Wickham,
Kent BR4 9EG

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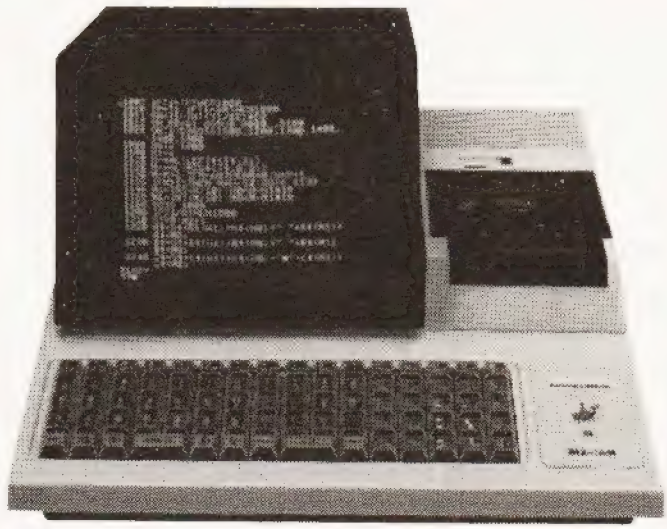

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If you have the tape-recorder interface for the Mk-14, you can use the device described this month to put the motor of the recorder under the direct control of the microprocessor. The circuit is easily adaptable to other systems too. Instead of your recorder being limited to the taping of programs, you can now use it to file away all kinds of data on tape. A tape recorder only gives serial access to data so it can never be as fast as a floppy disc system but, in spite of this, it adds a whole new dimension to small-system computing. If the tape carries membership details of your club or data about the customer accounts of your business, it is simple to scan the tape and list persons belonging to prescribed categories. For example, it can list the membership numbers of all members living in a certain district, or the reference numbers of customers who need sending a reminder to pay their account. If you are keen on computer 'music' the tape can carry a varied selection of coded tunes, to be loaded and played one after another. In educational programs, the storage of new information and coded messages is made easy by keeping it on tape. This device, in effect, gives you an enormous increase in memory space, making it possible to plan programs of much greater scope than before.

Circuit Details

As can be seen from Fig.1, the circuit is extremely simple. The output from Flag 0 is fed to the gate of a VMOS power transistor. This requires an exceedingly small current from the Flag 0 output, yet can switch a large load. The amount of current required is so small that you can turn on the relay by simply touching your finger against one of the wires of R1. The circuit is powered from the regulated or unregulated supply of microprocessor, or from an external supply. Diode D1 protects the transistor from damage by induced high voltages when the relay is switched off.

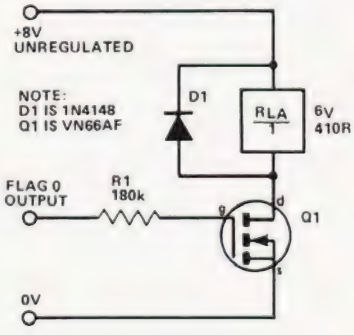
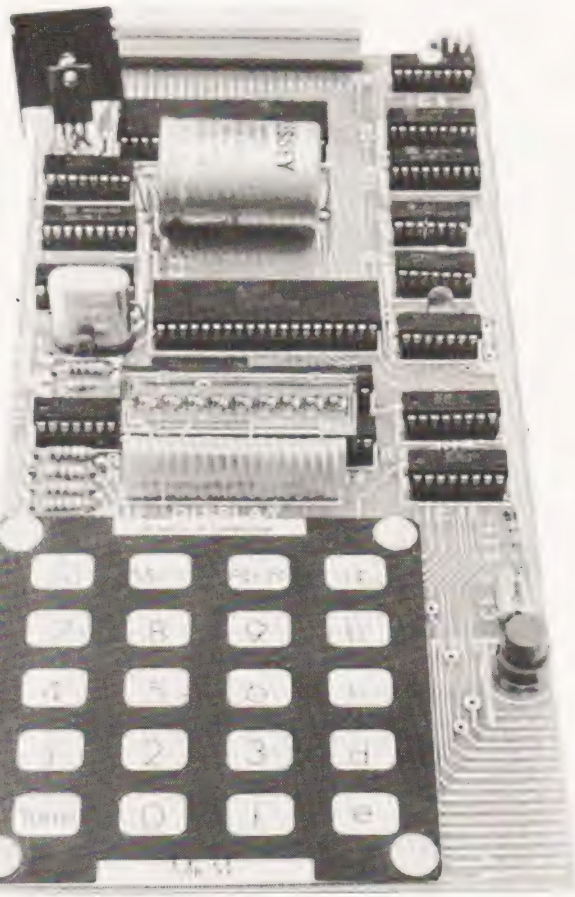


Fig 1. The circuit diagram for the tape controller.

The recorder is controlled by making use of its 'remote' socket. In most recorders that have this facility there is a subminiature (2.5 mm) jack socket adjacent to the miniature (3.5 mm) microphone socket. The relay is wired so that, when energised, it makes the connection between the tip and the sheath of a jack plug inserted in the 'remote' socket (Fig.2.).

It is worth noting that the VN66AF transistor can carry direct current up to 2 A and has a maximum drain-to source



voltage of 60 V. This circuit can, therefore, be used to switch motor-powered devices other than tape-recorders and is a generally useful interface. When operating at high currents, the transistor needs a heat-sink.

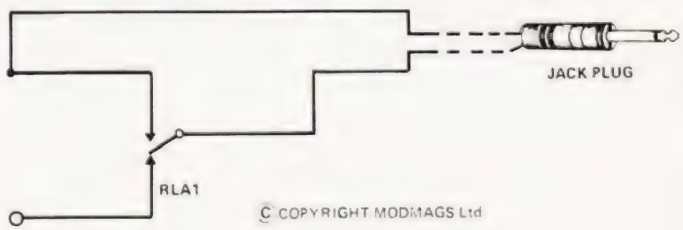


Fig 2. How to connect the relay.

Construction

Figure 3 shows the layout of the circuit board. To keep the relay contacts free of dust, the circuit is best housed in a small plastic case. It may be wired directly to the Mk-14 board as shown in Fig.4, or by way of the LED interface (CT, February 1980). In the latter event, the device is better controlled by using one of the Port B outputs of the I/O IC.

Software Control

The example given here can be modified for a variety of purposes. It can be accessed as a subroutine by setting Pointer 3 to 0FF6 and executing an XPPC. Otherwise, the entry point is at 0FD3. The listing is a modification of the usual 'load from tape' routine. The procedure is as follows:

PARTS LIST

Resistors ⅓ W, carbon film
R1 180k

Semiconductors
Q1 VN66AF VMOS power transistor
D1 1N4148

Miscellaneous
RLA1 6 V, 410R SPCO

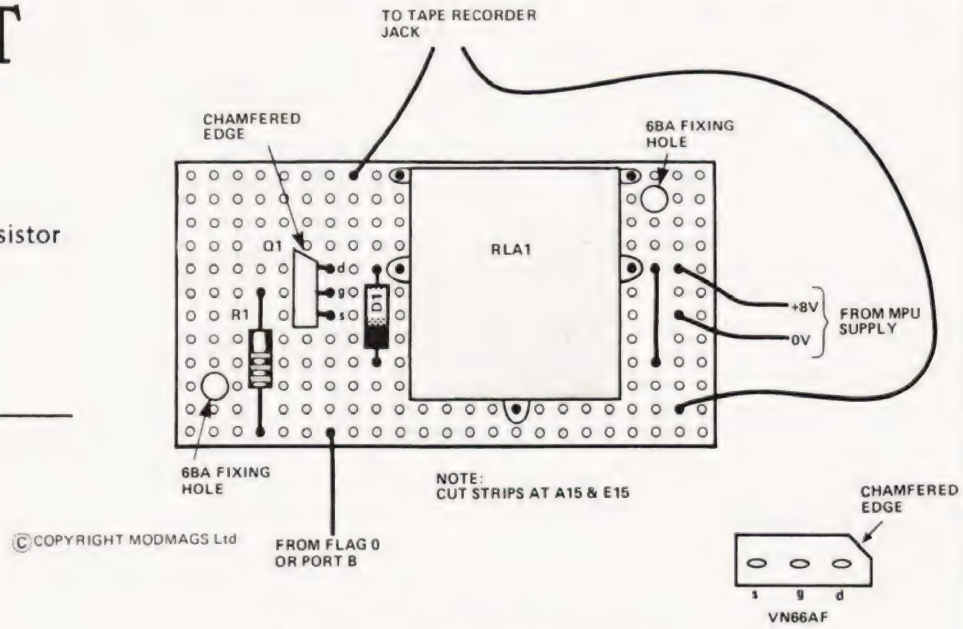


Fig 3. Veroboard overlay for the controller.

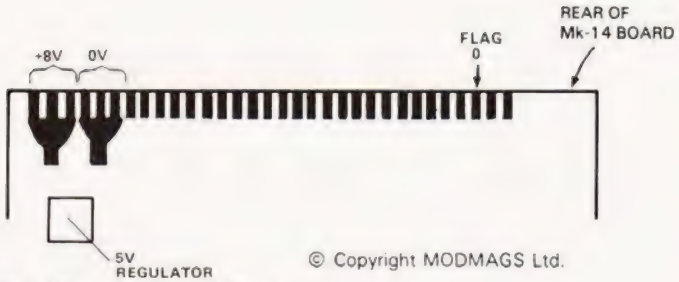


Fig 4. Where to connect Flag 0.

1. Turn the recorder on by making Flag 0 high.
2. Wait for the recorder to gain speed.
3. Wait until a recorded part of the tape is reached.
4. Read and store bytes from tape, counting the number of bytes stored.
5. Stop the recorder when the number of bytes required has been stored.

The number of bytes to be recorded is placed in 0FD1 before the program is run. This value needs to be reset for each run, and can be done by the main program so that different numbers of bytes can be read each time. Alternatively, a small addition to the program can reset 0FD1 automatically at the beginning of every run. The address for the beginning of the block of memory in which data is to be stored must be loaded in Pointer 1, as usual. If P1 is not reset each time the program is run, the sets of data will be stored in consecutive blocks of memory. At "Go" the program waits until the signal for the first bit is detected, it then reads and stores the preset number of bytes and switches off. If the program is re-started, the tape will have run on beyond the end of the previously recorded section and a 'nonsense' reading will be made.

The data should be stored in blocks, each containing an equal or lesser number of bytes than the number set at 0FD1. Between each block there should be a short unrecorded gap on the tape. This is easy to arrange when recording data using the normal 'store to tape' program. Each program stored on a tape is prefixed by a short identifying code, the code also contains the number of bytes of the program it prefaces. The micro reads the first byte (or first few bytes) of every block of data it comes across. It matches this against a code that has already been keyed in. When it finds a match, it stores the number of bytes of that program in 0FD, and then moves on to record the whole of the program. In this way, the Mk-14 is given the CLOAD function of the larger systems and a great deal of frustrating 'fast forward'-ing and 'fast rewind'-ing on the tape-recorder is avoided.

```
0FD1  0A          number of bytes to load
0FD2  00          bit counter
0FD3  C4 01  A:   LDI '01'     set Flag 0 high to start
0FD5  07          CAS          tape recorder
0FD6  8F FF       DLY          let speed build up
0FD8  8F FF       DLY
0FDA  C4 08  B:   LDI '08'     bit counter set to '08'
0FDC  C8 F5       ST
0FDE  06     C:   CSA          gives 00100000 if SENSE
0FDF  D4 20       ANI '20'     B is high
0FE1  98 FB       JZ B         go to B: if no signal
0FE3  8F 1C       DLY
0FE5  19          SIO          load bit in extension
0FE6  8F 1C       DLY
0FE8  B8 E9       DLD
0FEA  9C F2       JNZ C        go to C: if all eight bits
                               not loaded yet
0FEC  40          LDE          put byte in Acc
0FED  CD 01       ST@ + 1
0FEF  B8 E1       DLD
0FF1  9C E7       JNZ B        go to B:
0FF3  C4 00       LDI '00'     set Flag 0 low to stop
0FF5  07          CAS          tape recorder
0FF6  3F          XPPC         return to monitor
0FF7  90 DC  D:   JMP A        go back to A!
```

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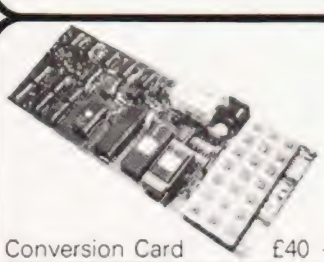

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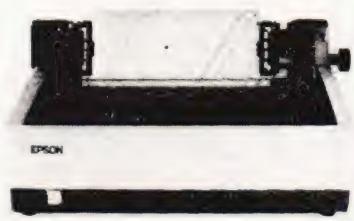

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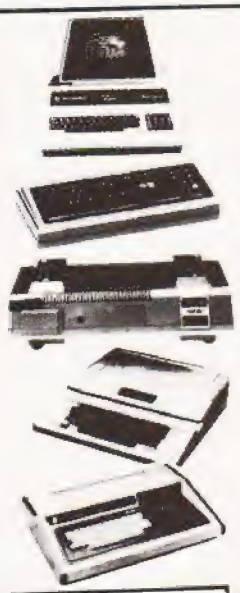

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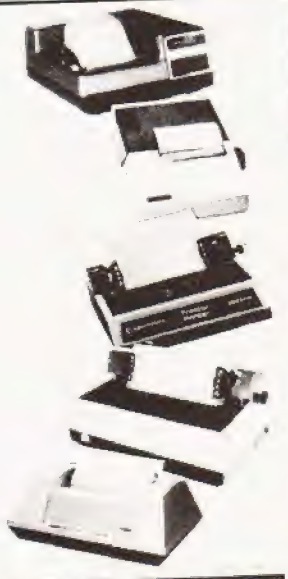

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Other fonts:- APL
Price:- £1,195

Options:- Full APL keyboard and character set, Overstrike.
Notes:- High quality VDU with APL capability and local printer port. Main appeal as remote terminal.

BURNT HILL ELECTRONICS

BH 711
Manuf. Burnt Hill Electronics
19 Holder Road
Aldershot
Hampshire GH12 4RH
0252-313701

Screen size:-12"
Char. size:- 7 x 5
Lines x Cols:- 16 x 64
CA:- –
Colour:- Green
Sp. Char.:- –
No. of keys:- N/A
Numeric pad:- N/A
Cursor keys:- N/A
Interface:- CCITT V24, 20mA
Baud rates:- 75-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- No
Price:- £656

Options:- Control and keyboard function re-assignment
Notes:- Rack mounting VDU for use with remote keyboards such as the BH 722 @ £204 or the BH 723 @ £173

BH 720
Manuf. As BH711

Screen size:-12"
Char. size:- 5 x 9
Lines x Cols:- 25 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- Yes
No. of keys:- 75
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- CCITT V24, 20mA
Baud rates:- 75-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- –
Price:- £892

Options:- Control and keyboard function re-assignment
Notes:- Free standing terminal with a number of pre-defined control functions built in.

BH 721
Manuf. As BH711

Screen size:-12"
Char. size:- 5 x 9
Lines x Cols:- 25 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- Yes
No. of keys:- N/A
Numeric pad:- N/A
Cursor keys:- N/A
Interface:- CCITT V24, 20mA
Baud rates:- 75-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- –
Price:- £862

Options:-
Notes:- Rack mount display terminal for use with remote keyboards such as the BH 722 or the BH 723

BH 912
Manuf. As BH711

Screen size:-12"
Char. size:- 7 x 10
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- –
Sp. Char.:- –
No. of keys:- 84
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232, 20mA
Baud rates:- 75-19,200
Printer port:- No
Light pen:- No
Other fonts:- –
Price:- £695

Options:-
Notes:- Micro controlled intelligent editing terminal

BH 920
Manuf. As BH711

Screen size:-12"
Char. size:- 7 x 10
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- —
Sp. Char.:- —
No. of keys:- 103
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232, 20mA
Baud rates:- 75-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- —
Price:- £895

Options:-
Notes:- Extended version of the BH 912 with a two page display memory.

CIFER SYSTEMS

MODEL 2602
Manuf. Cifer Systems Limited
Avro Way
Bowerhill
Melksham
Wiltshire SN12 6TP
0225-704502

Screen size:-12"
Char. size:- 7 x 11
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green optional
Sp. Char.:- Optional
No. of keys:- 62
Numeric pad:- No
Cursor keys:- Yes
Interface:- CCITT V24
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £728

Options:- Extra page memory, 20mA current loop interface
Notes:- Versatile medium priced VDU

MODEL 2603
Manuf. As MODEL 2602

Screen size:-12"
Char. size:- 7 x 11
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green optional
Sp. Char.:- Optional
No. of keys:- 62
Numeric pad:- No
Cursor keys:- Yes
Interface:- CCITT V24
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £745

Options:- As Model 2602
Notes:- Extended version of 2602 with visual highlighting and double size and flashing character capability

MODEL 2604
Manuf. As MODEL 2602

Screen size:-12"
Char. size:- 7 x 11
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green optional
Sp. Char.:- Yes
No. of keys:- 62
Numeric pad:- No
Cursor keys:- Yes
Interface:- CCITT V24
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £762

Options:- As Model 2602
Notes:- Extended version of the 2603 with overstrike graphics giving line drawing facilities

MODEL 2605
Manuf. As MODEL 2602

Screen size:-12"
Char. size:- 7 x 11
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green optional
Sp. Char.:- Optional
No. of keys:- 102
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- CCITT V24
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £829-862

Options:- Extra screen memory, 20mA current loop interface
Notes:- Full feature editing terminal with 25th status line display and a variety of display options

MODEL 2632
Manuf. As MODEL 2602

Screen size:-12"
Char. size:- 7 x 11
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green optional
Sp. Char.:- Optional
No. of keys:- 100
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- CCITT V24
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £997

Options:-
Notes:- Semi intelligent on or off-line editing terminal with a wide selection of pre-programmed functions

MODEL 2652
Manuf. As MODEL 2602

Screen size:-12"
Char. size:- 7 x 11
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green optional
Sp. Char.:- Optional
No. of keys:- 100
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- CCITT V24
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £963

Options:-
Notes:- Fully DEC VT52 compatible unit with several extra features taken from the 2605

DACOLL

MODEL 242-3
Manuf. Dacoll Engineering Services
Dacoll House
Gardners Lane
Bathgate
West Lothian, Scotland
0506-56565

Screen size:-12"
Char. size:- 8 x 7
Lines x Cols:- 25 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- —
No. of keys:- 82
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- CCITT V24, 20mA
Baud rates:- 110-9600
Printer port:- Yes
Light pen:- No
Other fonts:- —
Price:- £600

Options:- 132 columns. Second page memory, Full editing
Notes:- Versatile unit capable of being configured for a number of systems such ast VT52 or VIP 7250

MODEL 246
Manuf. As MODEL 242-3

Screen size:-12"
Char. size:- 8 x 7
Lines x Cols:- 25 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- –
No. of keys:- 94
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- Special
Baud rates:- –
Printer port:- Yes
Light pen:- No
Other fonts:- –
Price:- £1,100

Options:-
Notes:- A slave VDU designed to operate with the 245 controller which allows up to 8 units to emulate a specified protocol

ELBIT

DS 1920
Manuf. Elbit Data Systems
295 Aberdeen Avenue,
Slough, Berks. SL1 4HQ.
Slough 26713

Screen size:-12" or 15"
Char. size:- 5 x 8
Lines x Cols:- 24 x 80
CA:- –
Colour:- –
Sp. Char.:- –
No. of keys:- 63 or 95
Numeric pad:- –
Cursor keys:- –
Interface:- CCITT V24
Baud rates:- 110-9600
Printer port:- –
Light pen:- –
Other fonts:- –
Price:- £ – unknown

Options:- 20mA current loop interface, 7 x 8 character matrix
Notes:- Basic glass teletype with some editing functions and a detachable keyboard

DS 2000
Manuf. As DS 1920

Screen size:-15"
Char. size:- 8 x 10
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green optional
Sp. Char.:- –
No. of keys:- N/A
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS232
Baud rates:- 75-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- APL
Price:- £850-900

Options:- Amber screen, APL set and keyboard
Notes:- 48 line display memory with 1 page scrolling window or 2 pages Micro controlled terminal

DS 376
Manuf. As DS 1920

Screen size:-15"
Char. size:- 9 x 7
Lines x Cols:- 24 x 80
CA:- –
Colour:- Green optional
Sp. Char.:- –
No. of keys:- N/A
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- –
Baud rates:- –
Printer port:- Yes
Light pen:- No
Other fonts:- –
Price:- –

Options:- Amber screen
Notes:- Cluster terminal controller

HAZELTINE

MODEL 1410
Manuf. Hazeltine Ltd.
292 Worton Road
Isleworth
Middlesex TW7 6EL
01-568 1851

Screen size:-12"
Char. size:- 5 x 7
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- –
Sp. Char.:- –
No. of keys:- 65
Numeric pad:- Yes
Cursor keys:- No
Interface:- RS 232
Baud rates:- 110-9600
Printer port:- No
Light pen:- No
Other fonts:- –
Price:- £490

Options:-
Notes:- Bottom of the range, no frills VDU, ideally suited to the remote user or micro owner.

MODEL 1420
Manuf. As 1410

Screen size:-12"
Char. size:- 5 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- –
Sp. Char.:- –
No. of keys:- 78
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 110-9600
Printer port:- –
Light pen:- No
Other fonts:- Optional
Price:- £675

Options:- 20mA current loop interface, Printer port
Notes:- Terminal aimed specifically at the small business and word processing end of the market. Character set has true descenders

MODEL 1421
Manuf. As 1410

Screen size:-12"
Char. size:- 5 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- –
Sp. Char.:- –
No. of keys:- 78
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 110-9600
Printer port:- No
Light pen:- No
Other fonts:- Optional
Price:- £675

Options:- 20mA current loop interface
Notes:- Lear Siegler ADM 3A compatible version of the 1420

MODEL 1500
Manuf. As 1410

Screen size:-12"
Char. size:- 7 x 10
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- –
Sp. Char.:- –
No. of keys:- 74
Numeric pad:- Yes
Cursor keys:- No
Interface:- RS 232, 20mA
Baud rates:- 110-19,200
Printer port:- No
Light pen:- No
Other fonts:- Optional
Price:- £785

Options:-
Notes:- Unit supplied with an auxiliary port that could be used for a printer and also permits remote editing of screen data.

MODEL 1510
Manuf. As 1410

Screen size:-12"
Char. size:- 7 x 10
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- –
Sp. Char.:- –
No. of keys:- 81
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232, 20mA
Baud rates:- 110-19,200
Printer port:- No
Light pen:- No
Other fonts:- Optional
Price:- £880

Options:-
Notes:- Screen format mode, Memory protect, Reverse video selectable and remote editing capability.

MODEL 1520
Manuf. As 1410

Screen size:-12"
Char. size:- 7 x 10
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- –
Sp. Char.:- –
No. of keys:- 81
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232, 20mA
Baud rates:- 110-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £1,050

Options:- Auxiliary output port.
Notes:- Full microprocessor controlled, buffered data entry terminal with integral local printer interface.

MODEL 1552
Manuf. As 1410

Screen size:-12"
Char. size:- 7 x 10
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- –
Sp. Char.:- Yes
No. of keys:- 81
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232, 20mA
Baud rates:- 110-9600
Printer port:- No
Light pen:- No
Other fonts:- –
Price:- £975

Options:-
Notes:- DEC VT52 compatible terminal with several extra features.

EXECUTIVE 80-20/30
Manuf. As 1410

Screen size:-12" or 15"
Char. size:- 7 x 10
Lines x Cols:- 25 x 80 or 132
CA:- Yes
Colour:- Green
Sp. Char.:- –
No. of keys:- 108
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232/449, 20mA
Baud rates:- 110-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £ – TBA

Options:- Separate or integral keyboard, user programmable font
Notes:- Ergonomically designed VDU with audio or tactile feedback, smooth scrolling, 2 page screen memory, etc, etc

IBM (UK) LTD.

3101
Manuf. IBM (UK) Ltd.
PO Box 41
North Harbour, Portsmouth
Hampshire PO6 3AU
0705-694941

Screen size:-12"
Char. size:- 7 x 14
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- –
No. of keys:- 87
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232/422, 20mA
Baud rates:- to 9600
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £ – TBA

Options:- A wide variety of interface options, 3102 printer
Notes:- Very high quality ergonomically designed VDU made up of three discrete units with matching printer.

LEAR SIEGLER

ADM-3A
Dist. Penny and Giles Ltd.
Computer Peripherals Division
Mudeford
Christchurch
Dorset BH23 4AT
04252-71511
UK Importer,
many other local outlets.

Screen size:-12"
Char. size:- 5 x 7
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Optional green
Sp. Char.:- –
No. of keys:- 59
Numeric pad:- No
Cursor keys:- No
Interface:- RS 232, 20mA
Baud rates:- 75-19,200
Printer port:- No
Light pen:- No
Other fonts:- Optional
Price:- £492

Options:- Remote numeric data entry pad, Auto repeat, Lower case
Notes:- Basic VDU with standard upper case only.

ADM-3A +
Dist. As ADM-3A

Screen size:-12"
Char. size:- 5 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Optional green
Sp. Char.:- –
No. of keys:- 73
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232, 20mA
Baud rates:- 75-19,200
Printer port:- No
Light pen:- No
Other fonts:- Optional
Price:- £552

Options:- Auto repeat
Notes:- De-luxe version of the ADM-3A with true lower case and integral keypad.

ADM-31
Dist. As ADM-3A

Screen size:-12"
Char. size:- 7 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Optional green
Sp. Char.:- Optional
No. of keys:- 90
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232, 20mA
Baud rates:- 50-9600
Printer port:- Yes
Light pen:- No
Other fonts:- Various
Price:- £737

Options:- Direct polling of cursor position
Notes:- Two page memory device with micro control, full editing capability and programme personality.

ADM-42
Dist. As ADM-3A

Screen size:-15"
Char. size:- 7 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Optional green
Sp. Char.:- Optional
No. of keys:- 118
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232, 20mA
Baud rates:- 50-9600
Printer port:- No
Light pen:- No
Other fonts:- Optional
Price:- £1,170

Options:- 8 page memory, Printer port, Bus interface, etc, etc
Notes:- Three part VDU with virtually every option possible, lives up to the name of American Dream Machine, hence the initials!

LYME

MODEL 4002
Manuf. James Scott
Electronic Developments
2 Avenue Court,
Farm Avenue
London NW2
01-452 0490

Screen size:-12"
Char. size:- 12 x 7
Lines x Cols:- 24 x 80
CA:- –
Colour:- Green
Sp. Char.:- –
No. of keys:- 90
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 75-9600
Printer port:- No
Light pen:- No
Other fonts:- –
Price:- £625

Options:- See Models 4003-4006
Notes:- Two page memory terminal with integral programmable functions.

MODEL 4003
Manuf. As 4002

Screen size:-12"
Char. size:- 12 x 7
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- –
No. of keys:- 90
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 75-9600
Printer port:- No
Light pen:- No
Other fonts:- –
Price:- £625

Options:- See other models in range
Notes:- Enhanced version of 4002 with extra status line display and DEC VT52 compatability.

MODEL 4004
Manuf. As 4002

Screen size:-12"
Char. size:- 12 x 7
Lines x Cols:- 24 x 80
CA:- –
Colour:- Green
Sp. Char.:- –
No. of keys:- 90
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 75-9600
Printer port:- No
Light pen:- No
Other fonts:- –
Price:- £625

Options:- See other models in range
Notes:- Teletype or two page editing terminal configuration with block and line transmission capability.

MODEL 4005
Manuf. As 4002

Screen size:-12"
Char. size:- 12 x 7
Lines x Cols:- 24 x 80
CA:- –
Colour:- Green
Sp. Char.:- –
No. of keys:- 90
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 75-9600
Printer port:- No
Light pen:- No
Other fonts:- –
Price:- £625

Options:- See other models in range
Notes:- Data General 6053 compatible version of the 4003.

MODEL 4006
Manuf. As 4002

Screen size:-12"
Char. size:- 12 x 7
Lines x Cols:- 24 x 80
CA:- –
Colour:- Green
Sp. Char.:- –
No. of keys:- 90
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 75-9600
Printer port:- No
Light pen:- No
Other fonts:- –
Price:- £625

Options:- See other models in the range
Notes:- Hazeltine 1410 compatible version of the 4003.

MODEL 5000
Manuf. As 4002

Screen size:-15"
Char. size:- 12 x 7
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- Yes
No. of keys:- 102
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS232,20mA
Baud rates:- 75-9,600
Printer port:- Yes
Light pen:- No
Other fonts:- Yes
Price:- £745

Options:- 132 column screen, synchronous interface.
Notes:- Fully user programmable VDU with a choice of terminal emulations.

The new 5000 series VDU from Lyme.

LYNWOOD

BETA
Manuf. Lynwood Scientific Developments Ltd.,
Caker Stream Road,
Alton, Hampshire

Screen size:-
Char. size:- 7 x 11
Lines x Cols:- 30 x 80
CA:-
Colour:- Green
Sp. Char.:- –
No. of keys:- Choice
Numeric pad:- Optional
Cursor keys:- Optional
Interface:- V24, 20mA
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- –
Price:- £ –

Options:- Choice of keyboards
Notes:- Microprocessor controlled terminal with page memory. Slightly less sophisticated version of the ALPHA graphics terminal

MICRO TERM

ACT-V
Dist. Strumech
Portland House
Coppice Side, Brownhills
West Midlands
05433-4321

Screen size:-12"
Char. size:- –
Lines x Cols:- 24 x 80
CA:- –
Colour:- –
Sp. Char.:- Yes
No. of keys:- 77
Numeric pad:- –
Cursor keys:- –
Interface:- RS 232
Baud rates:- 110-9600
Printer port:- –
Light pen:- –
Other fonts:- –
Price:- £ – unknown

Options:-
Notes:- Screen display can be re-configured to 48 x 39.

NEWBURY LABORATORIES

MODEL 7000
Manuf. Hazeltine Ltd.
King Street
Odiham
Hampshire RG25 1NN
025-671 2910
6 Regional sales & service centres

Screen size:-12"
Char. size:- 7 x 5
Lines x Cols:- 24 x 80
CA:- –
Colour:- Green
Sp. Char.:- –
No. of keys:- 63
Numeric pad:- No
Cursor keys:- No
Interface:- CCITT V24,20mA
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- –
Price:- £495

Options:- Model 7001 with addressable cursor and page mode @ £595
Notes:- Microprocessor based "Glass Teletype" with 3 page memory

MODEL 7002
Manuf. As 7000

Screen size:-12"
Char. size:- 7 x 5
Lines x Cols:- 24 x 80
CA:- –
Colour:- Green
Sp. Char.:- –
No. of keys:- 74
Numeric pad:- Yes
Cursor keys:- No
Interface:- CCITT V24,20mA
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- –
Price:- £545

Options:- Model 7003 with addressable cursor and page mode @ £645
Notes:- More sophisticated version of the 7000 with several extras like video output and numeric keypad. 3 page memory as standard

MODEL 7007
Manuf. As 7000

Screen size:-12"
Char. size:- 6 x 8
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- –
No. of keys:- 91
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- CCITT V24,20mA
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- –
Price:- £745

Options:- 25th display line, Field protect, Extra page memory
Notes:- Full editing terminal with numerous features.

MODEL 7009
Manuf. As 7002

Screen size:-12"
Char. size:- 7 x 8
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- –
No. of keys:- 91
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS232C,20mA
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- –
Price:- £795

Options:- Displayable 25th line
Notes:- Seven page memory VDU with full screen formatting capability through keyboard and protected memory

PENTLAND

PENTLAND Mk VIII
Manuf. CPU Computers
St. Johns,
Woking,
Surrey.

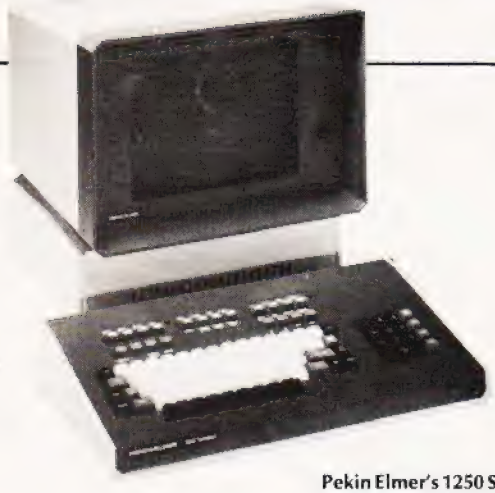
Screen size:-12"
Char. size:-
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- –
Sp. Char.:- Yes
No. of keys:- 90
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS232
Baud rates:- 50-9,600
Printer port:- No
Light pen:- No
Other fonts:- –
Price:- £465

Options:- 20 mA current loop, Auxiliary interface
Notes:- Newly introduced low-cost terminal

PERICOM DATA SYSTEMS

6801
Manuf. Pericom Data Terminals
1-3 Burners Lane, Kiln Farm
Milton Keynes
Bucks MK11 38A
0908-564747

Screen size:-15"
Char. size:- 7 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- Optional
No. of keys:- 87
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 75-9600
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £985



Pekin Elmer's 1250 Super Owl.

Options:- Extra page of screen memory.
Notes:- Ergonomically designed simple editing terminal.

6802
Manuf. As 6801

Screen size:-15"
Char. size:- 7 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- Optional
No. of keys:- 131
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 75-9600
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £1,085

Options:- Extra screen memory.
Notes:- Extended version of 6801 with 24 pre-defined function keys.

6803
Manuf. As 6801

Screen size:-15"
Char. size:- 7 x 9
Lines x Cols:- 24 x 132
CA:- Yes
Colour:- Green
Sp. Char.:- Optional
No. of keys:- 87
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 75-9600
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £1,285

Options:- Extended keyboard as the 6802.
Notes:- Designed for use in the word processing market with the wide screen display which can be reset to 80 columns.

6807
Manuf. As 6801

Screen size:-15"
Char. size:- 7 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- Optional
No. of keys:- 84
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 75-9600
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £1,350

Options:- Extended keyboard.
Notes:- Fully VT100 compatible terminal with four different character formats available.

PERKIN ELMER

BANTAM 550
Manuf. Perkin Elmer Data Systems
227 Bath Road
Slough, Berks SL1 4AX
0753-34511

Screen size:-12"
Char. size:- 5 x 9
Lines x Cols:- 24 x 80
CA:- —
Colour:- —
Sp. Char.:- —
No. of keys:- 66
Numeric pad:- Yes
Cursor keys:- No
Interface:- RS 232
Baud rates:- 110-9600
Printer port:- No
Light pen:- No
Other fonts:- Optional
Price:- £550

Options:- 20mA current loop interface, Printer port.
Notes:- Glass Teletype VDU.

SUPER OWL 1245/51
Manuf. As BANTAM 550

Screen size:-12"
Char. size:- 7 x 11
Lines x Cols:- 24 x 80
CA:- —
Colour:- Optional Green
Sp. Char.:- Yes
No. of keys:- 82 or 98
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 110-9600
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £1,250

Options:- Two types of detached keyboard, Light pen.
Notes:- Block mode editing terminal with special business form character set and 25th status line.

SOROC

IQ 120
Dist. Strumech
Portland House
Coppice Side, Brownhills
West Midlands
05433-4321

Screen size:-12"
Char. size:- 5 x 7
Lines x Cols:- 12 x 80
CA:- Yes
Colour:- —
Sp. Char.:- —
No. of keys:- 74
Numeric pad:- —
Cursor keys:- —
Interface:- RS 232
Baud rates:- 75-19,200
Printer port:- —
Light pen:- —
Other fonts:- —
Price:- £ — unknown

Options:- Block mode, Printer port.
Notes:- Functional basic editing terminal.

SOUTHWEST TECHNICAL PRODUCTS

CT-82
Dist. Southwest Technical
38 Dover Street
London W1
01-491 7507

Screen size:-8"
Char. size:- 7 x 12
Lines x Cols:- 16 x 82
CA:- Yes
Colour:- Green
Sp. Char.:- Yes
No. of keys:- 68
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 50-38,400
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £700

Options:- Light pen option, Various screen formats.
Notes:- Full editing terminal for use with the SWTP micros or as a stand-alone device.

TANDBERG

TVD 2200
Dist. Farnell International
Sandbeck Way, Wetherby,
West Yorkshire LS22 4DH
0937-63541

Screen size:-15"
Char. size:- 7 x 9
Lines x Cols:- 25 x 80
CA:- Yes
Colour:- Green
Sp. Char.:- Yes
No. of keys:- 122
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS422, V24
Baud rates:- 50-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- Yes
Price:- £1,200 approx.

Options:- 20 mA current loop.
Notes:- Ergonomically designed VDU with detached keyboard and programmable key functions.

TELERAY

MODEL 10
Dist. Teleprinter Equipment Ltd.
Akeman Street
Tring, Herts HP23 6AJ
044282-4011

Screen size:-12"
Char. size:- 7 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- —
Sp. Char.:- —
No. of keys:- 98
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 50-9600
Printer port:- Yes
Light pen:- No
Other fonts:- Optional
Price:- £680

Options:- Emulators for VT52, Data General and Prism.
Notes:- In common with the rest of the range the VDU has a choice of four casing options including rack-mount.

MODEL 11
Dist. As MODEL 10

Screen size:-12"
Char. size:- 7 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- —
Sp. Char.:- APL set
No. of keys:- 98
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 50-9600
Printer port:- Yes
Light pen:- No
Other fonts:- —
Price:- £680

Options:-
Notes:- The unit is supplied with the full APL character set including all the overstrike codes.

MODEL 12
Dist. As MODEL 10

Screen size:-12"
Char. size:- 7 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- —
Sp. Char.:- —
No. of keys:- 98
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 50-9600
Printer port:- Yes
Light pen:- No
Other fonts:- —
Price:- £870

Options:- 20mA current loop interface.
Notes:- De-luxe version of the "10" with extra programmable function space and a two page memory.

TELEVIDEO

TV1-912
Dist. Wilkes Computing Ltd.
Bush House
72 Prince Street
Bristol BS1 4HU
0272-25921

Screen size:-12"
Char. size:- 7 x 10
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- —
Sp. Char.:- —
No. of keys:- 84
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232, 20mA
Baud rates:- 75-19,200
Printer port:- No
Light pen:- No
Other fonts:- —
Price:- £585

Options:- 2 page memory, Printer port, VT52 emulation.
Notes:- Intelligent editor with standard features like Block mode and memory protect.

TV1-920
Dist. As TV1-912

Screen size:-12"
Char. size:- 7 x 10
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- —
Sp. Char.:- —
No. of keys:- 105
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232, 20mA
Baud rates:- 75-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- —
Price:- £685

Options:-
Notes:- Full feature editing terminal with remote editing capability.

VISUAL TECHNOLOGY

VISUAL 200
Dist. Wilkes Computing Ltd.
Bush House
72 Prince Street
Bristol BS1 4HU
0272-25921

Screen size:-12"
Char. size:- 7 x 9
Lines x Cols:- 24 x 80
CA:- Yes
Colour:- —
Sp. Char.:- —
No. of keys:- 93
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 110-19,200
Printer port:- Yes
Light pen:- No
Other fonts:- —
Price:- £795

Options:-
Notes:- Full feature editing VDU which is programmable to emulate Hazeltine 1500, ADDS 520, ADM-3A or DEC VT52 machines.

ZENITH DATA SYSTEMS

ZENITH Z19
Manuf. Zenith Data Systems
Bristol Road
Gloucester GL2 6EE
0452-29451
London shop — 01-636 7349

Screen size:-12"
Char. size:- 5 x 9
Lines x Cols:- 25 x 80
CA:- Yes
Colour:- —
Sp. Char.:- Yes
No. of keys:- 84
Numeric pad:- Yes
Cursor keys:- Yes
Interface:- RS 232
Baud rates:- 110-9600
Printer port:- No
Light pen:- No
Other fonts:- —
Price:- £851.25

Options:- 20mA current loop adaptor.
Notes:- Z80 based full editing terminal. The unit is also available as a 'Heathkit' to save money.

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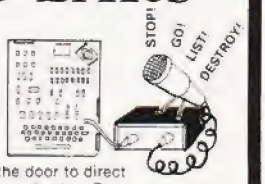

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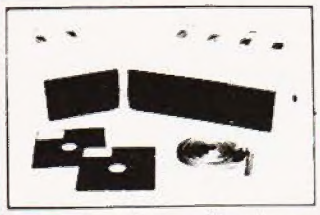

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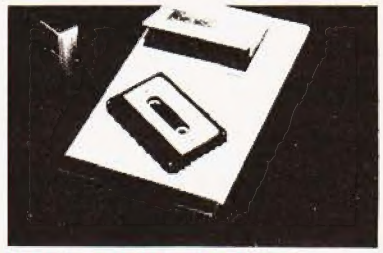

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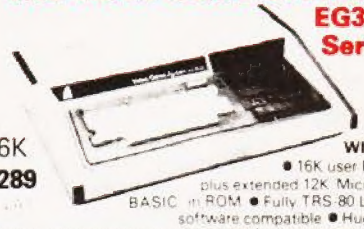

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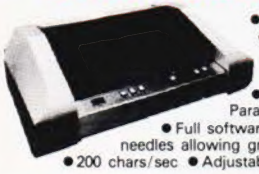

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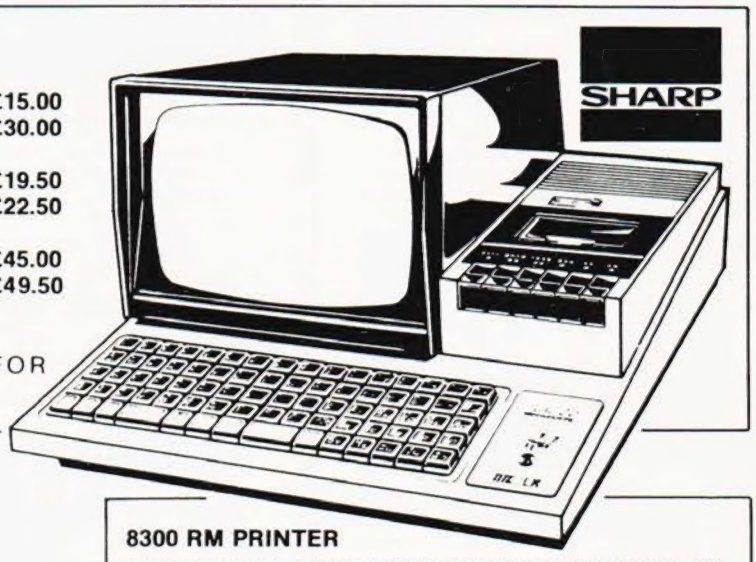

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